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INTEGRATED BATTLEFIELD EFFECTS RESEARCH FOR THE NATIONAL TRAINING CENTER

Appendix G—Capability of Off-the-shelf Pagers to Receive Transmissions in the Operational Areas of Fort Irwin, California

Science Applications International Corporation
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Technical Report

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Research performed to evaluate and develop enhancements for integrated battlefield training at the U.S. Army National Training Center is described. These enhancements had been identified and concepts developed for their application in earlier phases of this research. The report consists of the basic volume summarizing the research tasks, approach, results, conclusions, and recommendations; plus twelve appendices which provide details on the nine major tasks into which the research was divided. Research performed and the associated appendices are as follows:

—Development of nuclear and chemical environmental and effects software:
- Analysis of nuclear algorithms — Appendix A
- Requirements specification for nuclear and chemical model algorithms at the NTC — Appendix B
- Chemical model algorithm description — Appendix C

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11. TITLE (Continued)

Areas of Fort Irwin, California

19. ABSTRACT (Continued)

Demonstration of the system for combining live and notional battalions for training higher level staffs in integrated battlefield (IB) command and control:

Functional requirements analysis for IB command and control simulation	Appendix D
Report on the demonstration	Appendix E

Analysis and design of field simulators for nuclear and chemical warfare:

Technical and operational impacts of field simulators	Appendix F
Capability of off-the-shelf paging system to communicate at Ft. Irwin	Appendix G
Designs of field simulators	Appendix H

Adaptation of nuclear and chemical software to other Army training models:

Feasibility of transferring ARTBASS Code from Perkin-Elmer to VAX	Appendix I
Division/Corps training simulation functional analysis	Appendix J
ARTBASS conversion to VAX	Appendix K
Requirements specification for adding nuclear and chemical models to ARTBASS	Appendix L

This research provided the following products:

Software which models nuclear and chemical environment and effects with appropriate fidelity and timing for training and which is ready for installation on NTC computers.

A demonstrated capability for combining actions of real battalions with computer simulated notional battalions for training brigade/division commanders and staffs.

An analysis of the impacts of using field simulators at the NTC for nuclear and chemical warfare training, and the designs of the selected simulators (i.e., common control system, radiacmeters, dosimeters, chemical detectors).

Analysis of the application of nuclear and chemical models to other Army battalion training models; conversion of the ARTBASS model to operate on the VAX 11/780; incorporation of the nuclear and chemical models into ARTBASS; and demonstration of the nuclear and chemical models using ARTBASS.

CONVERSION FACTORS FOR U.S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

To Convert From	To	Multiply By
angstrom	meters (m)	1.000 000 x E -10
atmosphere (normal)	kilo pascal (kPa)	1.013 25 X E +2
bar	kilo pascal (kPa)	1.000 000 X E +2
barn	meter^2 (m^2)	1.000 000 X E -28
British thermal unit (thermochemical)	joule (J)	1.054 350 X E +3
cal (thermochemical)/cm^2	meta joule/m^2 (MJ/m^2)	4.184 000 X E -2
calorie (thermochemical)	joule (J)	4.184 000
calorie (thermochemical)/g	joule per kilogram (J/kg)*	4.184 000 X E +3
curie	giga becquerel (Gbq) †	3.700 000 X E +1
degree Celsius	degree kelvin (K)	$t_K = t°_C + 273.15$
degree (angle)	radian (rad)	1.745 329 X E -2
degree Farenheit	degree kelvin (K)	$t_K = (t°_F + 459.67)/1.8$
electron volt	joule (J)	1.602 19 X E -19
erg	joule (J)	1.000 000 X E -7
erg/second	watt (W)	1.000 000 X E -7
foot	meter (m)	3.048 000 X E -1
foot-pound-force	joule (J)	1.355 818
gallon (U.S. liquid)	meter^3 (m^3)	3.785 412 X E -3
inch	meter (m)	2.540 000 X E -2
jerk	joule (J)	1.000 000 X E +9
joule kilogram (J/kg) (radiation dose absorbed)	gray (Gy)*	1.000 000
kilotons	terajoules	4.183
kip (1000 lbf)	newton (N)	4.448 222 X E +3
kip/inch^2 (ksi)	kilo pascal (kPa)	6.894 757 X E +3
ktap	newton-second/m^2 (N-s/m^2)	1.000 000 X E +2
micron	meter (m)	1.000 000 X E -6
mil	meter (m)	2.540 000 X E -5
mile (international)	meter (m)	1.609 344 X E +3
ounce	kilogram (kg)	2.834 952 X E -2
pound-force (lbf avoirdupois)	newton (N)	4.448 222
pound-force inch	newton-meter (N·m)	1.129 848 X E -1
pound-force/inch	newton/meter (N/m)	1.751 268 X E +2
pound-force/foot^2	kilo pascal (kPa)	4.788 026 X E -2
pound-force/inch^2 (psi)	kilo pascal (kPa)	6.894 757
pound-mass (lbm avoirdupois)	kilogram (kg)	4.535 924 X E -1
pound-mass-foot^2 (moment of inertia)	kilogram-meter^2 (kg·m^2)	4.214 011 X E -2
pound-mass/foot^3	kilogram-meter^3 (kg/m^3)	1.061 846 X E +1
rad (radiation dose absorbed	gray (Gy)*	1.000 000 X E -2
roentgen	coulomb/kilogram (C/kg)	2.579 760 X E -4
shake	second (s)	1.000 000 X E -8
slug	kilogram (kg)	1.459 390 X E -1
torr (mm Hg, 0° C)	kilo pascal (kPa)	1.333 22 X E -1

*The gray (Gy) is the accepted SI unit equivalent to the energy imparted by ionizing radiation to a mass and corresponds to one joule/kilogram.

†The becquerel (Bq) is the SI unit of radioactivity; 1 Bq = 1 event/s.

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

SAIC is currently conducting research on how to enhance nuclear and chemical warfare training at the National Training Center. This research has identified a need for field simulators which provide appropriate indications of the simulated environment. Part of the current reserach is to provide preliminary designs for simulators of the IM-174 Radiacmeter, the IM-93 or 185 Dosimeter, and the M-43 Chemical Detector. A method of remotely controlling these simulators by utilizing off-the-shelf commercial pagers appeared to be cost-effective. There appeared to be a significant risk; however, in the ability of a transmission system, constrained by acceptable power levels and frequencies, to communicate with pagers throughout areas of interest at Fort Irwin. As part of the research defining field simulator operational impacts, SAIC had conducted an electromagnetic path loss survey on 27 and 28 October 1983 at Fort Irwin. (The survey is documented in Appendix B to "Technical and Operational Impacts of Field Simulators on the National Training Center" (draft technical report), SAI, 1 February 1984.) This survey measured path losses as high as 163.1 dB near the frequency of the pagers. These measured path losses raised considerable doubt that the pagers could adequately communicate when limited by transmission levels of twenty-five watts maximum which are permissible at Fort Irwin. At the same time, operational experience of Motorola pagers operating in urban areas indicated that they would operate acceptably in the Fort Irwin environment. Before proceding further with the field simulator design based on pagers, it was essential to resolve the question of whether or not they could operate acceptably. To answer this question SAIC tested the paging system at Ft. Irwin under field conditions. This report describes the test, its results, conclusions and recommendations. The test was conducted from 17 to 20 Septemeber 1984.

1.2 PURPOSE OF THE TEST

The purpose of the test was to verify the capability of commercial off-the-shelf Motorola paging system to communicate throughout an adequate area of Fort Irwin, so that the system could be used to provide remote control of nuclear and chemical field simulators. A secondary objective of the test was to provide a mapping of the pager communications coverage from selected transmission sites at Fort Irwin.

SECTION 2
APPROACH

2.1 GENERAL

Areas of interest in which nuclear and chemical simulators might be used were identified by coordinating with members of the Army Operations Group at Fort Irwin. An analysis which included results of a previous field strength survey, a requirement not to interfere with other systems, and experience with other radio frequency (RF) systems at Fort Irwin, indicated that three transmission sites had the potential of covering the entire area of interest while satisfying all constraints. Since only one transmitter could be economically obtained for the test, the total coverage for three transmitters was measured by transmitting from one site at a time and combining the results. Since the system design is based on sequential transmissions from the three transmitters, rather than simultaneous transmissions, the assumption that test results from each site are independent of the other sites appears to be valid. On successive days the transmitter was installed on each site and transmissions were made at exact five minute intervals. Personnel in jeeps, with watches synchronized with the transmitter crew, travelled prescribed routes throughout the area and recorded where transmissions were received and where they were not. Voice radio nets were available to further coordinate the test. The test required considerable advance coordination for permission to transmit on a given frequency, power levels, transmitter location, range clearance, ground transport, helicopter transport, electic power, and RF voice communication. Identification of coordination required and accomplishment of that coordination will be useful later in defining corresponding considerations and actions which will be required in implementing the selected field simulators system. To document and facilitate necessary coordination for the test, a field simulation transmission test plan was prepared and updated as appropriate. The final version of the plan is provided in Attachment 1.

2.2 TRANSMITTER AND ANTENNA

The transmitter was a Motorola Paging Universal Remote Control (PURC), Model Number C73JZB, with a power output of 50 to 100 watts and a frequency range of 132 to 174 MHz. For the test it was set to a frequency of 148.825 MHz. Power output of the transmitter for the test was fifty watts which was attenuated by an estimated factor of two by the 100 foot antenna lead, so that the power input to the antenna was approximately twenty-five watts. A brochure describing the transmitter is provided in Attachment 2.

Address codes and messages to the pagers were input to the transmitter using a Motorola MODEN Plus, Model Number EO8PLS2000 T. A brochure describing this equipment is provided in Attachment 3.

The antenna incorporated an off-the-shelf Decibel Products Model DB-224 mast and array. When this two piece antenna was assembled its length was 255 inches. This antenna was combined with an SAIC special design, portable mast, base, and reflector. The base consisted of a tripod and twenty foot steel mast which when assembled, and anchored by about fifteen sandbags provided integral necessary stability in high winds. When disassembled the entire antenna assembly could be carried in a truck or internally in a UH-1 helicopter. The antenna focused power, downward and over about a 220 degree arc. There was also a reduced power rear lobe. The downward focusing and reduced rear lobe will reduce any problem of interference with Goldstone and spectrum analysis receivers mounted at the tops of Mount Tiefort and Granite Peak. A brochure describing the DB-224 and a drawing of the SAIC antenna assembly are provided in Attachment 4.

2.3 RECEIVERS

Two two types of receivers were used. One was a Motorola ENVOY model off-the-shelf pager which simply provides an output signal (selectable as an audio signal or blinking light). This page is used in the design of the chemical detector simulator, and is the most economical design where only an on/off signal is required. The other receiver was a Motorola Model BPR 2000 pager, which is also off-the-shelf. This pager can receive signals of up to twenty-four characters in length. This pager is used in the design of the radiacmeter and dosimeter field simulator. Its use is appropriate in applications where more information (e.g. radiation rate levels) is required. Brochures describing the two pagers are provided in Attachment 5.

2.4 CONDUCT OF THE TEST

For the first day of monitoring, the transmitter location was Goat Mountain. The transmitter was located about two hundred meters to the west of the Amex generator and antennas location on Goat Mountain. The test antenna was pointed to the west. This provided essentially line of sight coverage throughout the Live Fire area, and also provided some coverage of the east end of South and Central corridors. For the second day of monitoring the transmitter was placed on LFA 1, with the antenna pointed to the south east. This provided coverage primarily of Central Corridor and the east and west ends of South Corridor. For the third day of monitoring, the transmitter was placed at the NASA

Site on Mount Tiefort with the antenna pointed to the south east. This provided coverage primarily to South Corridor, with some additional coverage of the east end of the other corridors.

Four monitor teams were used, with one monitor team in each corridor (South, Central, and Live Fire), and one monitor team concentrating on areas of special interest for the particular transmission site. Each day the monitor teams assigned to corridors followed the same path. Paths had been selected based on coordination with NTC operations personnel to cover areas of difficult reception and areas of particular interest in nuclear and chemical warfare operations, as well as to measure overall area coverage. Each monitor team was mounted in a jeep provided by the Army. The team consisted of two people: an Army driver, who was a noncommissioned officer familiar with operations in the area, and a recorder. Two recorders were Army noncommissioned officers and two were engineers or technicians from SAIC and Motorola. Each team was equipped with one of the two types of pagers described in Section 2.3 above.

At the beginning of the test each day, monitor teams were initially positioned where receipt of the first signal was essentially certain. Voice communication with each team and the transmission site was established using a combination of radio nets with VRC-46 tactical radios and commercial radios. When it had been confirmed that all monitor teams had received the first page, all monitor teams moved out on their assigned monitor routes. During the test, transmissions were made every five minutes. Each monitor team plotted on a map its location at the time of transmission and indicated whether or not a signal was received on its pager.

SECTION 3
RESULTS

Figures 1 through 4 (following page 6) show the points at which receipt of transmissions were tested. A gray circle represents a successful receipt of the signal. A dark square indicates a failure to receive a transmission. The figures are based on reductions of Ft. Irwin North and South 1:50,000 maps. Grid squares are one kilometer on a side.

3.1 COVERAGE FROM GOAT MOUNTAIN

The transmitting antenna was located on Goat Mountain at coordinates (495293) and pointed at 240 degrees azimuth. The 220 degree main lobe of the antenna pattern is shown by the dotted lines. Coverage from Goat Mountain is shown in Figure 1. Coordinates at which readings were taken, and results of readings are shown in Table 1. All points in the Live Fire Corridor could be covered from this site. Transmissions were received at the bottom of a canyon about two miles to the rear of the antenna and at the base of hills directly in front of the antenna where the hill appeared to most effectively block the line of sight to the transmitting antenna.

3.2 COVERAGE FROM LFA 1

The transmitting antenna was located on LFA 1 at coordinates (376212) and pointed at 150 degrees azimuth. Coverage from LFA 1 is shown in Figure 2. Coordinates at which readings were taken and results of readings are shown in Table 2. All points in the Central Corridor were covered except for a small area in the western end of the corridor. This area was covered by transmissions from Mt. Tiefort, however, transmissions were also received throughout the Red Lake area at the east end of the South Corridor. This area had been identified as one in which all types of radio frequency transmissions were severely limited.

3.3 COVERAGE FROM MOUNT TIEFORT

The transmitting antenna on Mount Tiefort was located at the NASA Site, coordinates (401031) and pointed at 150 degrees azimuth. Coverage from Mount Tiefort is shown in Figure 3. Coordinates at which readings were taken and results of readings are shown in Table 3. All points in the South Corridor were covered except for the Red Lake area at the east end of the corridor and a small area in the east end in Grid Square (5110). The Red Lake area was covered however from LFA 1 and Grid Square (5110) appears to be covered from Goat Mountain.

From Mt. Tiefort, the areas in the west end of central corridor, which were missed by transmissions from LFA 1, were adequately covered.

3.4 GENERAL COVERAGE

Figure 4 shows the coverage from the combination of all three transmission sites. All areas were covered by transmissions from at least one site. Parts of the Red Lake area at the east end of the South Corridor were covered only by transmissions from LFA 1. Parts of the west end of the Central Corridor received transmissions only from Mount Tiefort. Much of Live Fire received transmissions only from Goat Mountain.

There are about six isolated points at which a dark square is not covered by a gray circle. These dark squares are points where the monitor team was located at the time of a transmission from a site which did not cover that point. On days when these points would have been adequately covered, the monitor team was not at these exact points when a transmission was made, since the monitor team followed a prescribed route, but did not go to a specific point for each transmission. In each such case, after examining the terrain and antenna locations, it appears valid to project coverage of these points based on coverage of nearby locations with similar lines of sight to a transmitter.

3.5 RECEIPT OF SIGNALS INSIDE A TANK

In previous analysis and field strength tests it appeared that it would not be possible to communicate directly with pagers inside a tank or armored personnel carrier. To verify this, a single test was made in which a pager was carried inside an M-60 tank which was then completely buttoned up. The tank appeared to be in its operational configuration. Contrary to expectations, signals were received from Mount Tiefort. The transmission path was line of sight and about twelve kilometers long.

3.6 BATTERY LIFE

Fresh batteries were installed in pagers at the beginning of each day. No other battery changes were required.

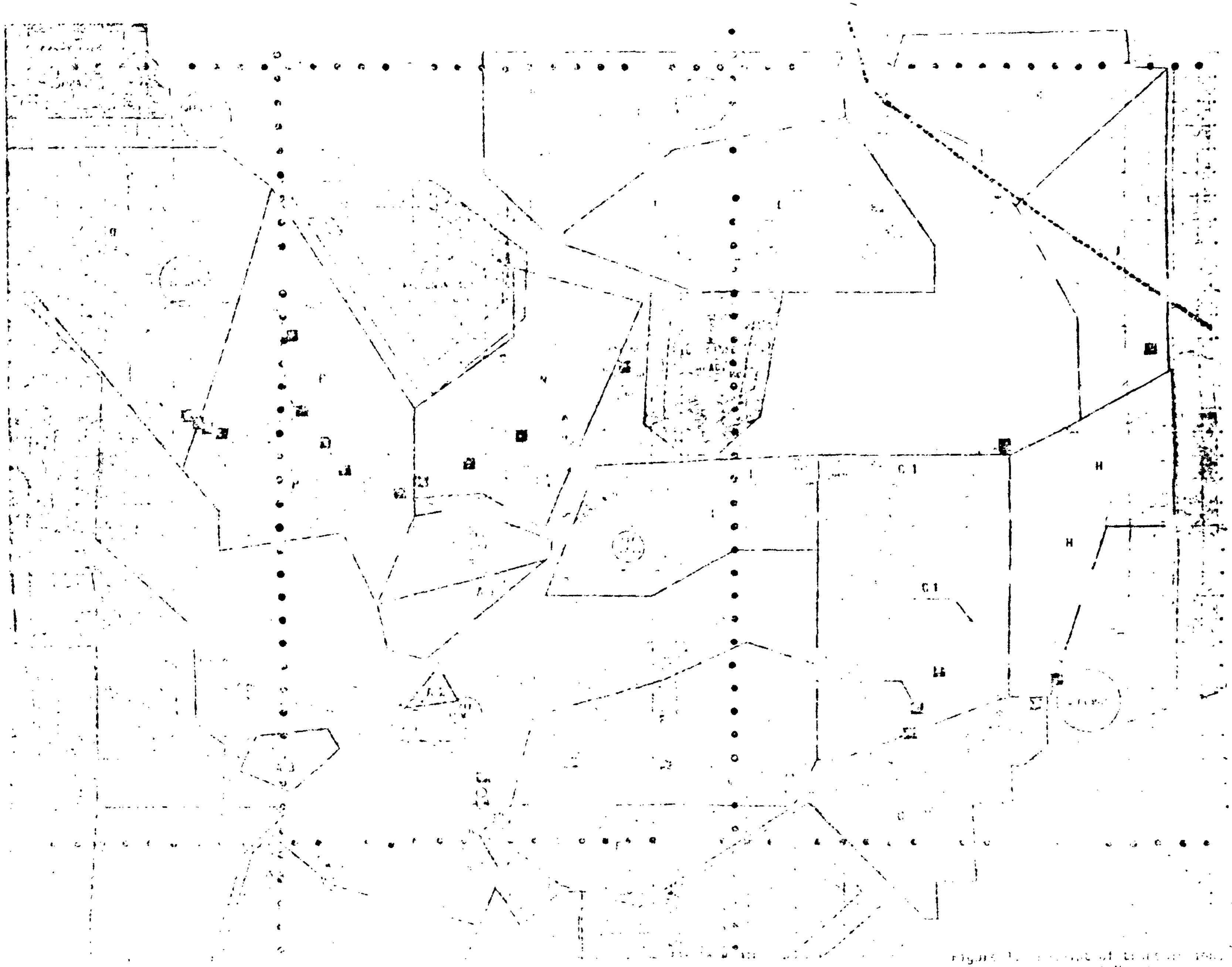
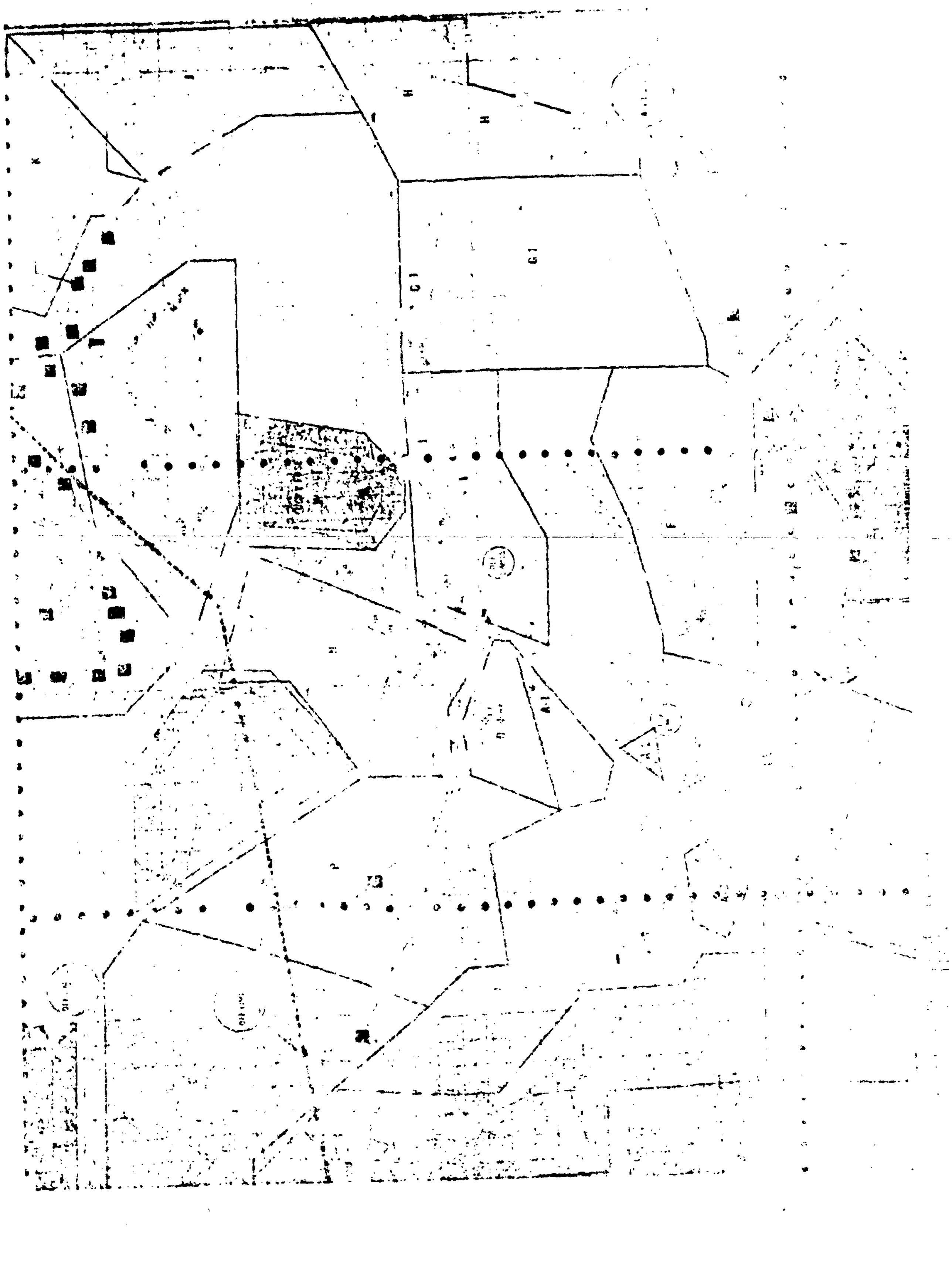


Figure 1.



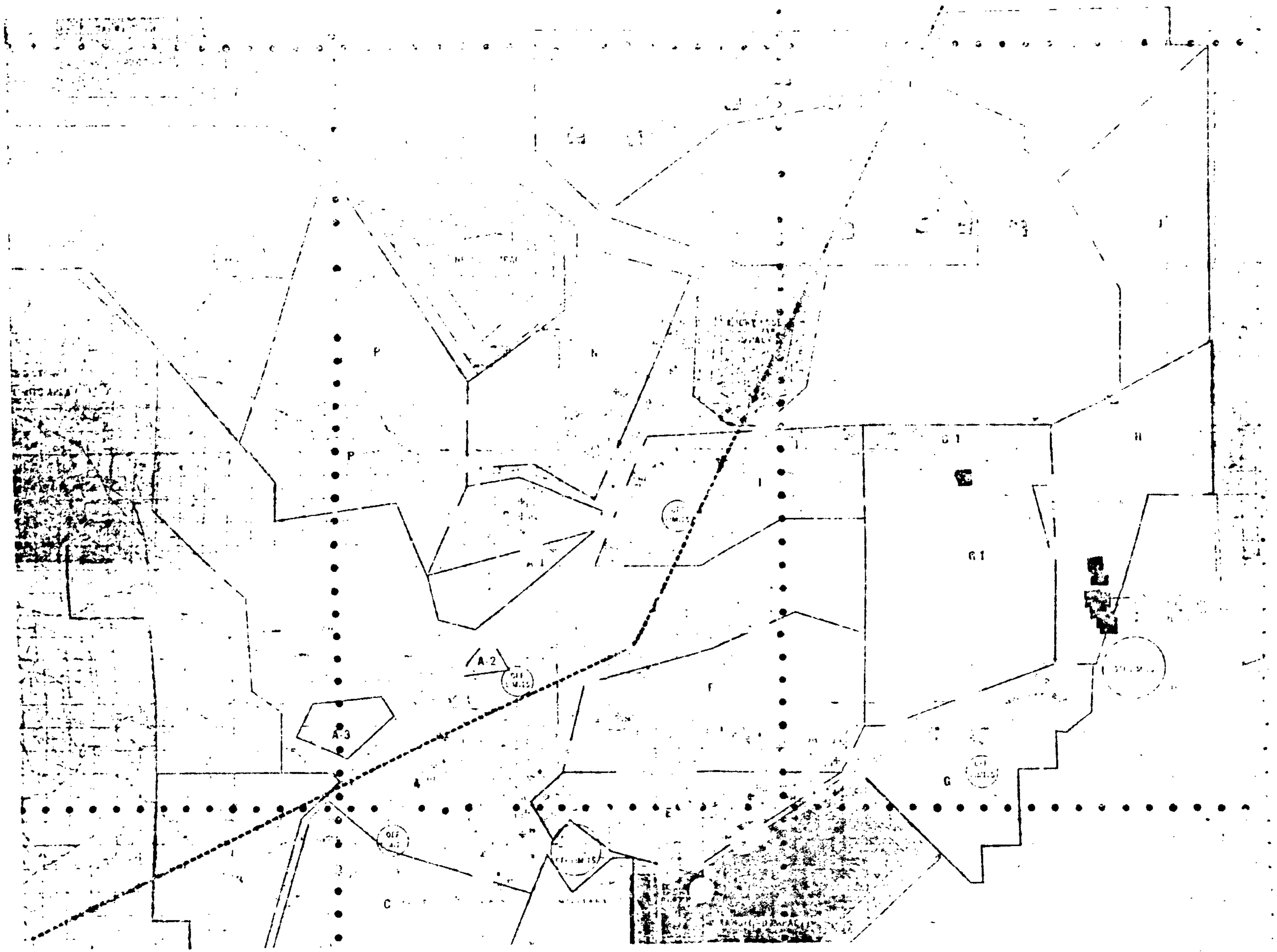


Figure [illegible]

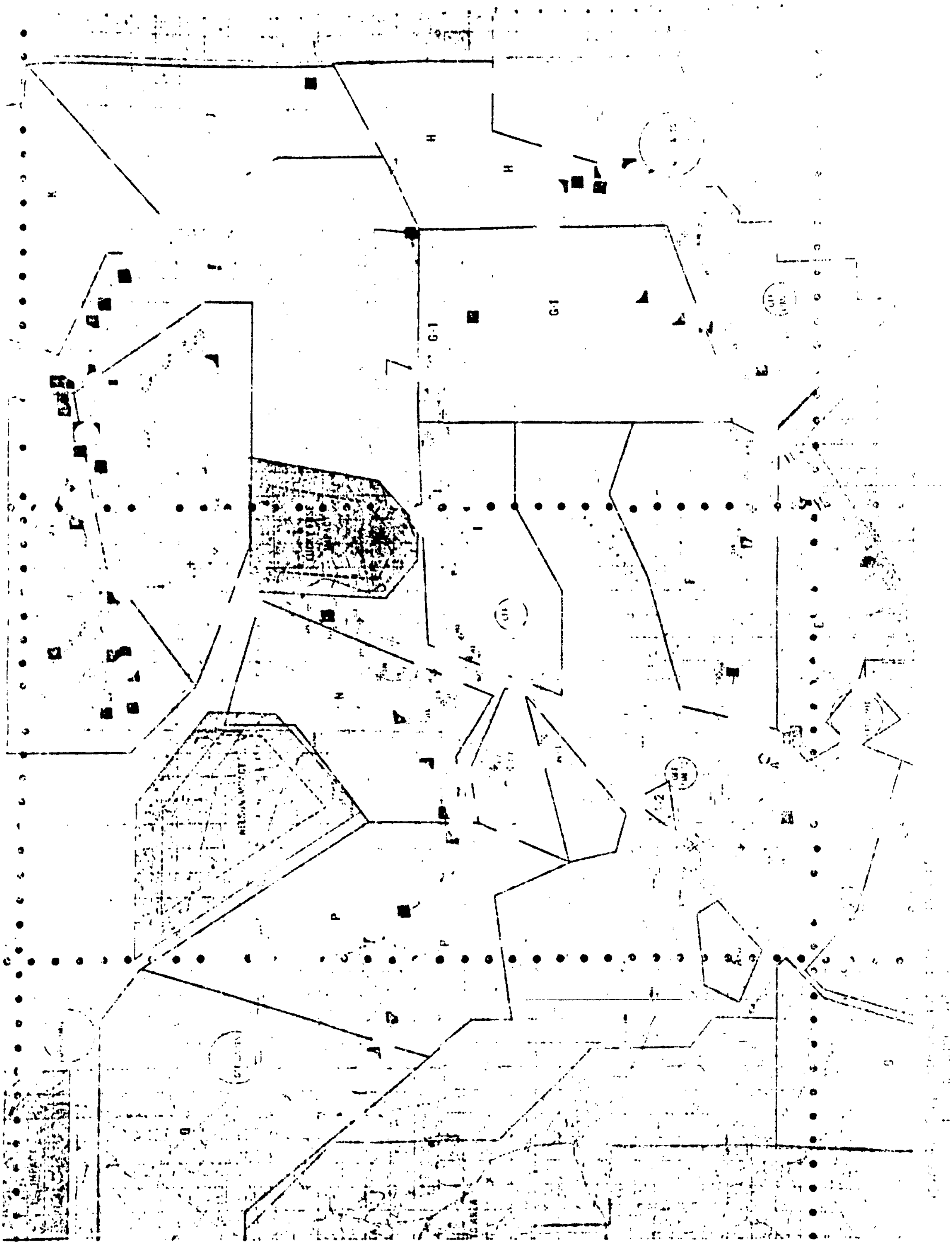


Table 1. Results of transmission test from Goat Mountain.

Transmissions were received by the Live Fire Corridor Monitor at the following coordinates:

Coordinates	Time
444225	Not Recorded
429210	
492220	
509219	
540215	
557206	
570212	
571243	
546240	
540249	
545259	
505270	
440285	
407285	
386282	
362288	
347278	
368252	
381256	
401255	
409271	
449270	
465268	
454288	
472290	
485265	

There were no points at which the Live Fire Corridor Monitor did not receive transmissions from Goat Mountain.

Table 1. Results of transmission test from Goat Mountain (continued).

Transmissions were received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
370127	Not Recorded
248170	
212197	
193188	
186174	
183157	
193151	
200149	
223137	
238124	
260120	
271106	
294092	
318088	
535122	
521111	
510100	
499098	
465104	
407107	
427097	
402081	
375098	
402108	

Transmissions were not received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
346138	Not Recorded
324126	
302118	
295114	
271124	
264135	
253149	
248183	
204148	
210144	
214142	
220139	

Table 1. Results of transmission test from Goat Mountain (continued).

Transmissions were received by the South Corridor Monitor at the following coordinates:

Coordinates		Time
477987		1150 hrs
503991		1155
490988		1200
522997		1205
584077		1220
546078		1225
536058		1230
524042		1235
492003		1300
476988		1310
476000		1325
375940		1330
337949	Assume	1335
299935	Assume	1340
263959		1345
270965		1350
315983		1355
344996		1415
394960		1425
405962		1430
410964		1435
422971		1440
468986		1450

Transmissions were not received by the South Corridor Monitor at the following coordinates:

Coordinates		Time
523039		1240
512022		1245
509016		1250
509011		1255
410945		1325
261958		1345
338972	Assume	1400
337973		1405
328992		1410
364966		1420
405997		1455

Table 1. Results of transmission test from Goat Mountain (concluded).

Transmissions were received by the Roving Monitor at the following coordinates:

Coordinates	Time
491290	Recorded as Shown
496290	
491277	
481294	
478288	
468295	
461292	
465288	
471283	
447284	
444285	
434287	
439268	
443229	
408199	
371121	1250
361098	
323054	
311040	
332029	
337028	
354023	
359010	
391002	
446987	
468986	
496989	
522998	
572041	1425
582075	
556227	

Transmissions were not received by the Roving Monitor at the following coordinates:

Coordinates	Time
388168	
419993	1340
561023	1405/1410
570033	1420
548133	
610175	

Table 2. Results of transmission test from LFA-1.

Transmissions were received by the Live Fire Corridor Monitor at the following coordinates:

Coordinates	Time
527219	
511218	
480215	
464215	
454213	
440218	
460235	
419286	
393280	
401253	
403248	
406247	
405259	
415270	
449287	
456291	
478286	
539249	
549259	
541221	
568231	
574208	
560203	

Transmissions were not received by the Live Fire Corridor Monitor at the following transmissions:

Coordinates	Time
485258	
474278	
439285	
376283	
349291	
349276	
349260	
350248	
363247	
375252	
382254	
397257	
429274	
452263	
468267	
467292	
487281	
519261	

Table 2. Results of transmission test from LFA-1 (continued).

Transmissions were received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
323082	
312085	
282100	
263115	
259122	
243126	
235128	
212143	
184177	
195193	
218197	
246170	
271123	
300111	
318127	
352135	
371129	
305109	
321111	
371118	
378118	
352076	
392076	
423090	
420105	
410114	
430131	
492132	
531121	
462107	
440111	

Transmissions were not received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
191152	
255147	

Table 2. Results of transmission test from LFA-1 (continued).

Transmissions were received by the South Corridor Monitor at the following coordinates:

Coordinates	Time
499046	
521066	
536078	
557064	
584075	
575050	
572041	
567032	
563028	
554015	
519996	
511993	
498990	
481989	
460978	
443968	
429958	
359943	
314938	
282934	
260957	
268962	
310980	
320985	
331982	
333992	
345991	
349971	
372961	
396960	
423971	
466987	

Transmissions were not received by the South Corridor Monitor at the following coordinates:

Coordinates	Time
389941	1320
302977	1350
410965	1430
449975	1440

Table 2. Results of transmission test from LFA-1 (concluded).

Transmissions were received by the Roving Monitor at the following coordinates:

Coordinates	Time	Remarks
370212		
390212	1200	
394200		
402201		Against Mountain
442221		
481258		
552233	1245	
563221		
580204	1255	
586154	1305	
593116		
572047		
565040		Way Back in Draw
565029	1325	
541007		
411952		
406951		
407949		
382940	1410	
331951		
321969		
293006		
284023		

Transmissions were not received by the Roving Monitor at the following coordinates:

Coordinates	Time	Remarks
491268		Against Mountain
511267		
530251		
491988	1335	
466986	1340	
439969	1345	

Table 3. Results of transmission test from Tiefort Mountain.

Transmissions were received by the Live Fire Corridor Monitor at the following coordinates:

Coordinates	Time
402249	
349292	
381281	
411283	
548259	
546240	
540221	
554230	
567235	
567216	
574196	
564202	
555205	
542212	
523215	
452230	
485259	
475287	
468294	
448293	
445288	

Transmissions were not received by the Live Fire Corridor Monitor at the following coordinates:

Coordinates	Time
371254	
347257	
439281	
480277	
489274	
538217	
515216	
497218	
465215	
467270	
446271	
415271	

Table 3. Results of transmission test from Tiefort Mountain (continued).

Transmissions were received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
329078	
318088	
292092	
281107	
251125	
230135	
217140	
201149	
186153	
184169	
197192	
217197	
249191	
249180	
257147	
284117	
297113	
320128	
369129	
308111	
361118	
370119	
430132	
493135	
527121	
502101	
40[illegible]09	
390105	
372100	
359089	

Transmissions were not received by the Central Corridor Monitor at the following coordinates:

Coordinates	Time
512107	

Table 3. Results of tramsmission test from Tiefort Mountain (continued).

Transmissions were received by the South Corridor Monitor at the following coordinates:

Coordinates	Time	Remarks
353021		
356011		
354003		
372999		
401999		
427990		
447987		
468985		
449972		
428958		
418950		
385939		
348946		
308936		
276935		
271965		
291959		
294974		
312981		
326984		
326993		
336995		
344990		
358963		
374959		
395960		
411966		
428973		
447975		
329030		
310039		
291024		Reading taken inside M60 A1 Tank (Buttoned up).

There were no points at which the South Corridor Monitor did not receive transmissions from Tiefort Mountain.

Table 3. Results of tramsmission test from Tiefort Mountain (concluded).

Transmissions were received by the Roving Monitor at the following coordinates:

Coordinates	Time	Remarks
298002		
306993		
326968		
366944		
393942		
424954		
461980		
469987		
481002		
491012		
512014		
514023		
530053		
548078		
563075		
563025		
537006		
503991		
441987		
407998		
397002		
356017		
357046		
362071		
362096		
369116		
399115		
429126		
425091		
405081		
389078		Bottom of Small Canyon
379076		

Transmissions were not received be the Roving Monitor at the following coordinates:

Coordinates	Time	Remarks
567070		
570065		
567053		
573052		
572049		Edge of Small Canyon
567043	1105	Back into Small Canyon
571042		

SECTION 4
CONCLUSIONS

Transmissions can be received by off-the-shelf Motorola pagers throughout all areas of interest on the Ft. Irwin reservation from at least one of the three transmission sites tested while operating at acceptable power levels. Although future operational use or more extensive testing may show that transmissions cannot be received in a few isolated ravines or canyons from any of the three locations, no such locations were found in the tests.

In at least some cases, transmissions can be received inside completely buttoned-up M-60 tanks. No controlled test of this capaility was conducted so more definitive results under operational conditions are not available.

SECTION 5
RECOMMENDATIONS

It is reccmmended that work be continued on the design of field simulators in which Motorola pagers and transmitters operating at approximately 150 MHz are used for remote control of the field simulators.

It is recommended that further tests be conducted on the capability of pagers inside tanks and armored personnel carriers to receive signals.

It is recommended that tests be conducted using pagers in a fully operational environment to insure that there is no significant loss of effectiveness of either pagers or other electronic systems.

It is recommended that the process be initiated to secure a permanently assigned frequency at Ft. Irwin to be used in the operational training system for radio frequency control of pagers.

ATTACHMENT 1
TEST PLAN

FIELD SIMULATOR TRANSMISSION TEST PLAN

1.0 INTRODUCTION

1.1 Purpose of the Test

The purpose of the test is to verify the viability of the concept of using a commerical off-the-shelf (COTS) Motorola pager system as the common control system for nuclear and chemical field simulators at the U.S. Army National Training Center (NTC). The test will verify the capability of the pagers to reliably receive control signals in the NTC environment. A secondary objective is to obtain a rough mapping of where signals can be received using a system of the type tested.

1.2 Applicability

This plan is the basis for the test preparation, coordination, and execution. In the course of planning, the test the plan has been updated to include an increasing degree of detail, and to reflect results of coordination and planning meetings.

1.3 Content

This plan includes the following:

- Purpose of the test
- Test approach, including concept, equipment and personnel requirements
- Test preparation
- Conduct of the test
- Recording and reporting

1.4 Test Organization

Test Director is Julius Ickler of Science Applications International Corporation (SAIC). Deputy Director is Joe Birney of SAIC. Names, addresses and telephone numbers of

test participants and those with whom coordination may be required are in Enclosure 1.

2.0 APPROACH

2.1 Concept

Initially a transmitter and antenna of the type and having the capability of the operational system will be placed on Goat Mountain, LFA1 and Mt. Tiefort respectively on three successive days. A commercial encoder driven by a microcomputer will provide a constant input of a typical control message which will be repeated every minute throughout the test period.

One monitoring party per corridor, mounted in jeeps, will travel throughout each operating corridor (South, Central, Live Fire) on selected routes. The routes will crisscross each corridor so that a thorough sampling of reception in the corridor is obtained. A fourth monitoring party will monitor areas of importance for the transmission site being used that day. In areas of acceptable reception on roads, monitoring parties will also test reception in nearby depressions or ravines. Each monitoring party will be equipped with a standard COTS pager and a map. Each monitoring party will track its location on the map and record on the map its route and whether or not signals were received on the pager.

One day will be required to test the transmission from Goat Mountain with monitoring parties concurrently located in the South Corridor, Central Corridor, and Live Fire Area.

On successive days, the transmitter will be moved to LFA 1 (Hill 1497), and Mt. Tiefort. For each transmitter location, all three corridors will be tested in order to evaluate the capability of the operational system when signals may be sequentially transmitted from two or three locations.

The transmitter and antenna package will be delivered by motor vehicle for the Goat Mountain and LFA1 sites. The transmitter and antenna package will be delivered by motor vehicle to the Ft. Irwin heliport, where it will be loaded and delivered by U.S. Army helicopter to the Mt. Tiefort NASA site. At the end of the day the helicopter will return the transmitter to the heliport. The transmitter and antenna package will be internally loaded on the helicopter. Drivers, recorders, maps, and one-quarter ton trucks will be provided by the Army as requested in the 19 June SAIC letter to LTC Fitzgerald.

2.2 Equipment Required

2.2.1 **Transmitter System**		1 each
a.	Transmitter (Motorola)	1 each
b.	Encoder (Motorola)	1 each
c.	Micro Computer Input (SAIC)	1 each
d.	Antenna SDI 220 degree cardioid 8 db	1 each
e.	Control Radio (Net control station) (Motorola)	1 each
f.	Transport vehicle (SAIC)	1 each
2.2.2 **Monitoring Teams**		4 each
a.	1/4-Ton Truck (GFE)	1/Team
b.	Pager with spare batteries (Motorola)	1/Team
c.	Maps (GFE)	1/Team
d.	Control radio (GFE) VRC-46 (or equal)	1/Team

2.3 Personnel

2.3.1 Transmitter Operators

a. SAIC	2	
b. Motorola	2	
c. AMEX	part time	(electrical power technician to fuel generator, maintain power generator, turn power transmission at site on and off at beginning and end of each day)

2.3.2 Mobile Monitor Team (four teams)

a. Pager Operator/Map Reader (SAIC) 2 (Army) 2
b. Driver (Army) 4

2.4 Data Reduction and Reporting

2.4.1 Monitoring Parties

Each monitoring party will provide daily to the test director a map overlay showing its routes, points, and times where control signals were received.

2.4.3 Site Preparation

Sites ready at three locations for antenna mounting with a 20 foot minimum mast height required. Power 60 cycles 120v @ 6.7 amps during setup and testing.

3.0 TEST PREPARATION

Test preparation consists of securing permission and clearance to use Ft. Irwin on the appropriate dates, clearance to transmit under specified conditions, arrangements to secure equipment and arrangements for operational and logistic support. Enclosure 2 is a PERT chart which shows the time critical actions. Enclosure 3 is a check sheet showing actions required, person to accomplish the action, and deadline date. Spaces are provided for entering date of completion and remarks.

4.0 CONDUCT OF THE TEST

Test procedures are provided in Enclosure 4.

5.0 RECORDING AND REPORTING

Recording and reporting requirements and procedures are provided in Enclosure 6.

PERSONNEL INFORMATION

Program Monitor:	Major Rudy Rushing (505) 844-3724 Major Johnnie Grant Field Command, Defense Nuclear Agency
Program Manager:	Dr. David Erickson, (619) 456-6458 SAIC
Deputy Program Manager Test/ Director:	Julius Ickler (619) 456-6357 SAIC P.O. Box 2351 La Jolla, California 92038
Deputy Test Director:	Joe Birney (619) 456-6101

SAI Test Coordinators and Participants:

John Hafer	(619) 456-6387
J.R. Robinson	(619) 456-6694
Gerry Wilson	(619) 456-6137

TRADOC Coordinator:	LTC Fitzgerald (804) 727-3978/2983 LTC Closkey

NTC Army Communications Command:

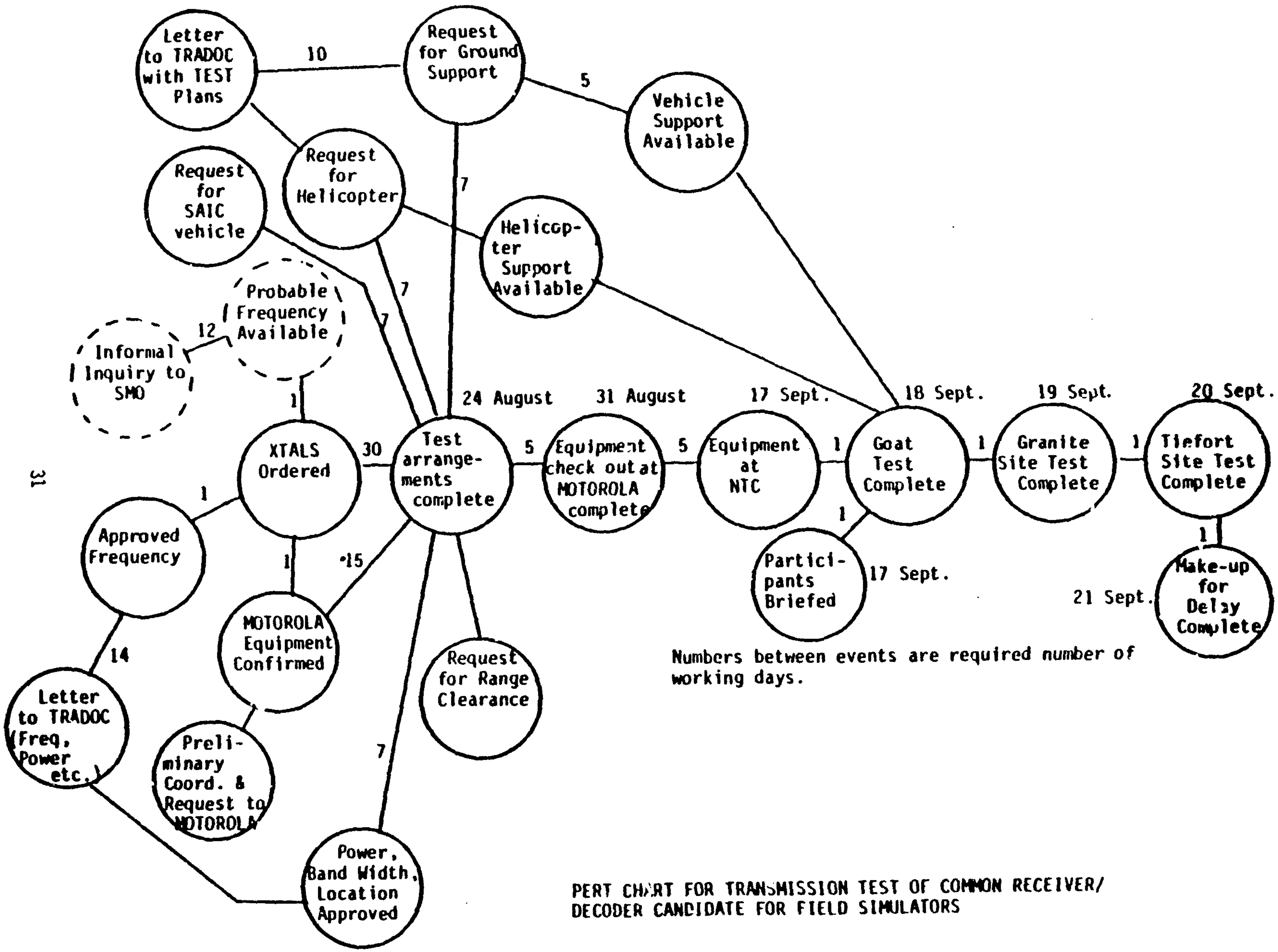
Maj. York	(619) 386-3002
Mr. Cushman	
Mr. Pankey	

NTC Operations Group Contact:	LTC Wyatt (619) 386-5087
NTC AMEX on Site Manager:	R. Besner (619) 386-1600
NTC SAI on Site Manager:	R. Dickson (619) 386-5066
Motorola Coordinator:	M. Coffin (619) 578-2222 M. Mosher R. Roth
NTC ILS COR:	LTC Richard S. Meyers AFZJ-DCI (619) 386-3792

PERSONNEL INFORMATION
(continued)

ARMY PARTICIPANTS

TEAM 1	(South Corridor)	DRIVER:	SFC R. Jackson
		MONITOR:	1st day - Mark Coffin (Motorola) 2nd day - R. Roth (Motorola) 3rd day - G. Wilson (SAIC)
TEAM 2	(Central Corridor)	DRIVER:	Sp4 B. Cunningham
		MONITOR:	SFC G.A. White
TEAM 3	(Live Fire)	DRIVER:	Cpl. J.W. Sage Jr.
		MONITOR:	SFC M.E. Prichett
TEAM 4	(Corridor Depends on Transmission Site)	DRIVER:	SFC R.R. Kasperski
		MONITOR:	J. Ickler (SAIC)



Numbers between events are required number of working days.

PERT CHART FOR TRANSMISSION TEST OF COMMON RECEIVER/ DECODER CANDIDATE FOR FIELD SIMULATORS

Enclosure 2

SAIC TRANSMISSION TEST CHECK SHEET

ACTION REQUIRED	ASSIGN TO	DEADLINE	DATE COMPLETE RECONFIRMED	REMARKS
Transmission approval requested	Ickler	20 Aug	13 July	verbal, J. Ickler
Range requested	Ickler	15 June	13 July	verbal, LTC Fitzgerald
Approval for transmission	Ickler	20 Aug	16 July	verbal, Maj. York
Approval for range	Ickler	20 July	13 July	verbal, LTC Fitzgerald
Transmitter Configuration Finalized	Birney	21 May	31 May	25 W, 8 db, Ant.
Crystals ordered	Birney	4 June	5 June	148.825 MHz
Transmitter requested	Birney	6 June	11 June	
Transmitter received	Birney	24 Aug	10 Aug	
Encoder requested	Birney	6 June	11 June	
Encoder received	Birney	2 July	7 Aug	
Pagers requested	Birney	6 June	14 Aug	
Pagers received	Birney	12 Sept		
Support requested				
Helicopter	Ickler	8 June	19 June	Need to reconfirm for later dates
Vehicles	Ickler	8 June	19 June	" "

Personnel				
Army	Ickler	8 June	19 June	" "
Motorola	Birney	8 June	11 June	" "
SAIC	Ickler	8 June		
Other	Ickler	8 June		
Maps	Ickler	8 June	19 June	" "
Logistic Support approved				
Helicopter	Ickler	22 Aug		" "
Venicles	Ickler	22 Aug		" "
Personnel				
Army	Ickler	22 Aug		" "
Motorola	Birney	22 Aug		" "
SAIC	Ickler	22 Aug		" "
Other	Ickler	22 Aug		" "
Maps	Ickler	22 Aug		" "
Antenna mount fabricated	Ickler/ Birney	8 June	8 June	" "
Antenna available	Birney	2 July	2 July	
Preliminary test of antenna erection procedure and equipment	Birney	27 Aug	27 Aug	
Reservation at Motel in Barstow	Richmond	27 Aug		17, 18, 19, 20, 21 September Howard Johnson 6 rooms

A4.0

TEST PROCEDURES

This attachment defines the sequence and procedures to be used in the test. The test will be performed by a Transmitter Team and, six Monitor Teams. The Test Director will provide coordination and a central point of contact. There will also be logistic support requirements preceding and during the test. Table 4-1 is a schedule of the test events.

The Transmitter Team consists of the following:

Joe Birney - SAIC Team Leader

Jerry Wilson - SAIC Technical

Mike Mosher - Motorola Sales Manager

Robert Roth - Motorola RF Specialist

Rod Reid (Power Technician, AMEX)

The Transmitter Team will be equipped with a rented enclosed truck. Communication will be provided by a Motorola radio and an SAIC radio which can tie into the telephone system.

There will be four Monitor Teams. Each team will consist of two people:

Team leader/map reader/recorder (SAIC or Army 2 from each)
Driver (Army)

Each Monitor Team will be equipped with a 1/4-ton, 4x4 truck (jeep), a VRC-46 radio and a pager receiver, and adequate batteries for all day operation.

For the flights to and from Mt. Tiefort, transmitter equipment will be loaded internally in the helicopter by the transmitter team subject to instructions by the aircraft commander or crew chief.

A4.1 Events Prior to 17 September.

During the week of 27-31 August, Joe Birney will assemble and test equipment in the test configuration at the Motorola facility in San Diego. The transmitter, computer driver, encoder, and all pagers will be tested as a system. Administrative radios will also be checked. He will then

supervise packaging of equipment for transport to Ft. Irwin.

Prior to 17 September the Transmission Team leader will personally reconnoiter each transmission site to insure that access, sufficient power cable, and other needs are available.

A4.2 Events on 17 September (Monday)

At 09:00 the Test Director will brief Army members on monitor teams and confirm that all equipment is available to the monitor teams.

From 11:00 to 17:00 Army test participants will correct deficiencies detected during the briefing. At 15:00 the CIS the test director will check with all the transmitter teams as set up for the following day.

From 06:00 to 12:00 the Transmitter Team will load its equipment and transport it to Ft. Irwin.

From 12:00 to 15:00 Monitor Team will set up the antenna at Goat Mountain.

4.3 Events on 18 September (Tuesday)

Transmitter Team

7:00	Check in with Test Director at CIS.
7:00 - 9:00	Travel to Goat Mountain, final setup equipment, prepare to transmit.
9:00 - 15:00	Transmit from Goat Mountain with one tranmission at each five minute interval.
15:00 - 17:00	Load equipment, return to CIS, prepare for following day, report on operations to Test Director, secure equipment.

Monitor Teams

7:00 - 8:00	Secure and load equipment.

8:00		Check with Test Director at CIS. Pickup pagers, batteries, commercial radios.
8:00 -	9:00	Travel to initial monitoring point.
9:00 -	15:00	Monitor while following prescribed routes.
15:00 -	16:00	Return to CIS, provide written and verbal report and overlay to Test Director. Prepare for following day operations. Turn in pagers, batteries, commercial radios.

A4.4 Events on 19 September (Wednesday)

Transmitter Team

7:00		Check with Test Director at CIS.
7:00 -	9:00	Travel to LFA 1, set up equipment, prepare to transmit.
9:00 -	15:00	Transmit from LFA 1, with one transmission at each five minute interval
15:00 -	18:00	Load equipment, return to CIS, report on operation to Test Director prepare equipment for helicopter transport, secure equipment.

Monitor Teams

Same as 18 September

Tracking Teams

Same as 18 September

4.5 Events on 20 September(Thursday)

Transmitter Teams

6:30	Check with Test Director at CIS

6:30 -	7:00	Load equipment, travel to helipad.
7:00 -	7:30	Load equipment for internal transport to Mt. Tiefort.
7:30 -	8:30	Transmitter Team and equipment delivered by helicopter to Mt. Tiefort.
8:00 -	9:00	Set up equipment at Mt. Tiefort on NASA site.
9:00 -	15:00	Transmit from Mt. Tiefort with one transmission at each five minute interval.
15:00 -	16:00	Take down equipment and deliver to helicopter pickup point.
16:00 -	17:00	Load and return personnel and equipment to helipad.
17:00 -	17:30	Return equipment to secure storage area. Report to Test Director.

Monitor Team

Same as 18 September.

A4.6 Events on 21 September (Friday)

Friday is a make-up day in event that weather precludes flying on Thursday, or occurrence of other delays. If there is no testing required, the day will be spent in preparing equipment for shipment to San Diego, or storage, and returning borrowed equipment. The Test Director will determine what is to be done on 21 September and inform each team leader when he checks in at the close of business on 20 September.

COMMUNICATIONS

A Communications Operating Procedure with frequency, call signs, and operating times will be arranged on 17 September.

Communication will be provided using Army VRC-46 radios and radios provided by Motorola and/or SAIC.

PREVIOUS PAGE IS BLANK

MONITOR TEAM ROUTES AND REPORTS

Monitor teams will follow routes indicated on map overlays which are provided. In areas which have good reception on roads, the team should make side trips off the roads to test reception in draws and ridges where field simulators might be used. The side trips should be made whenever it appears that line of sight conditions are changed significantly. Side trips should be made about every two kilometers along a road, and should normally be about one kilometer from the road.

Notes should be taken on the reception. The route along the road should be marked with a solid line. Mark places with adequate reception with an X, mark places with poor reception with a O. Write in notes which may be of interest. For example: "No reception in draw, but good reception 50 yards away on ridge."

Make sure that your batteries are good. There is a signal on the pager to indicate when batteries are low. Please note when you had to change batteries and record this in your report.

Julius Ickler will be in the field during the tests. If you get back before he does, leave your reports, pager, and nongovernment radios in LTC Wyatt's office. If you have observed something that needs to be be changed before the following day, please wait to see Julius Ickler that afternoon.

ATTACHMENT 2
TRANSMITTER

Eq Cat	Sec	Item
R3	2.1	75A

MOTOROLA

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PURC Radio Paging Stations

Continuous Duty

30-50 MHz, 50-100W variable
132-174 MHz, 50-100W variable
406-420 MHz, 30-75W variable
450-470 MHz, 30-75W variable
470-512 MHz, 30-80W variable

PURC Radio Paging Stations

Feature	Description	Benefits
Advanced Station Design	Advanced in every sense of the word these stations feature: • Top performance transmitter rated for continuous duty operation • Variable power output • Advanced mechanical design with unified circuit chassis	Designed for high quality reliable operation, these stations are built with state-of-the-art technology. The highest reliability semiconductor devices are used throughout the station. Easily accessible printed circuit board assemblies and plug in remote control modules enhance fast easy maintenance testing and repair
All Solid State	100% solid state transmitter and power supply mean greater reliability and efficiency	Solid state paging stations provide you with instant full rated transmit power. Cooler operation means longer component life with minimal maintenance
Continuous Duty Operation	These radio paging transmitters offer continuous duty operation with full rated power. No performance degradation even with excessive line voltage (± 20%) or excessive temperature (+60°C)	Continuous duty operation means reliable station performance
Jackfields	Built in jackfields allow for line bridge and station metering and level settings	Jackfields are integrated into the line driver module, eliminating bulky intercabling
Tone or Binary Signaling	A single station can be used for either tone or binary signaling formats. Each station can accommodate two tone 5/6 tone and binary FSK-NRZ codes	The same station can be used for tone only or tone and voice paging systems. This built in flexibility enhances compatibility with almost any type of system including those with visual, audible or silent alerting
Remote or Local Control	A choice of modem, tone remote or local control is available. Remote control permits station control over any voice frequency patch while modem control is used for binary applications. Local control can be used when the station is located within 100 feet of the terminal	Tone control eliminates the need for costly wireline with DC continuity and can also be used over radio links, thus eliminating the need for leased phone lines. Binary signaling provides increased versatility
Cabinet Versatility	Stations are available in compact cabinets that are rugged yet attractive enough for any office environment. For outdoor applications, a weather resistant outdoor cabinet is available	These vinyl covered cabinets will maintain their good appearance for years and are not subject to chipping or scratching
Maintenance Features	Plug in modules, standard 19 inch rack mounting and metering sockets are standard	Maintenance checks and servicing are completed quickly and easily. Plug in modules and standard size rack mounting allow for easy removal and replacement of parts if necessary
Factory Pre-Test	All stations are operated in the factory under normal operating conditions prior to shipping	Factory pre-testing helps eliminate problems which might otherwise occur during initial operation
Simulcast Control	Simulcast models include a plug in card that responds to the Simulcast System Controller at the paging terminal	The simulcast control module provides individual paging station control over the common RF Link or other audio path. Stations may be keyed together for full simulcast area coverage, in groups for sector control applications, or individually for system maintenance purposes

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Feature	Description	Benefits
True DC Modulation	Binary FSK-NRZ data can be transmitted without minimum low frequency limits. A data "one" or "zero" shifts the carrier frequency and holds it there as long as necessary. After the complete data message is transmitted, the carrier returns to the precise center frequency for voice messages.	There are no disallowed codes in any format. Users can send any data message, including alphanumeric strings to display pagers, without restrictions. Without true DC response, messages could be lost due to data distortion and average center frequency drift.
High Stability Synthesizer	A standard reference oscillator with ± .0000002% temperature stability and ± .00001% per year aging rate precisely controls frequency in simulcast models. Independent FSK plus and minus deviation adjustments along with true DC modulation, allow the carrier to be offset for binary signaling and to be on precise center frequency for voice messages.	A standard frequency reference reduces the long factory lead time normally required for high stability oscillators cut to specific frequencies. The high stability provides low simulcast distortion for voice messages. Independent FSK deviation adjustments reduce signaling errors in binary messages. Thus, the synthesizer provides optimal simulcast performance for systems that mix tone signaling, binary signaling and voice messages.
Flat Transmitter Audio Response	A plug in card alters audio response from the standard 6 dB per octave pre-emphasis to "flat" response.	This type of response profile is better suited to tone signaling than are pre-emphasis schemes. The danger of lost or "falsed" tones is greatly reduced.
Voice-Actuated Response (VAR)	A plug in card, in conjuction with the flat audio module allows the station to automatically switch between flat and pre-emphasized audio for tone and voice paging when using 2 or 5/6 tone signaling.	Voice actuated response eliminates the need for separate phone lines for paging signaling tones and audio.
Wattmeter	An internally mounted RF wattmeter is available on all models as an option.	Allows in system measurement of forward and reflected power.
Full DC Metering	Internally mounted meter measures all essential circuits.	This option greatly simplifies station metering and tuning.
75 MHz 450 MHz 900 MHz Link Receivers	Link receiver option is available installed in a standard paging station. Option includes flat receiver and transmitter audio as well as "Digital Private-Line" coded squelch.	This option offers an alternative to wireline transmitter control. In addition to its cost-effectiveness, a link receiver provides improved audio to the system. "Digital Private-Line" squelch reduces "skip" interference.
Monitor Receiver	100% solid state design gives you a highly reliable receiver. Excellent selectivity helps users pick up proper signals. The monitor receiver can be installed in the station (if the link receiver is not used) or in a separate 19" rack mounted chassis.	The monitor receiver is required to prevent co-channel interference between users sharing the same channel in a given area.
Power and Audio Level Verification	A contact closure is available to confirm proper transmitter power and audio modulation.	This feature helps provide the most efficient and reliable paging service possible today.

PURC Radio Paging Stations

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Performance Specifications
General

Model Series	Frequency (MHz)	Watts	Cabinet Height	AC Power Input	Control	No. of Frequencies
C[illegible]2B	30 5[illegible]	50 120 variable	46	120 VAC 60 Hz standard 220 VAC 50 Hz optional	tone remote simulcast control	1
C[illegible]2B	[illegible] 174					
C64[illegible]2B	406 42[illegible] 45[illegible] 4[illegible]	30 75W variable				
	4[illegible] 512	30 6[illegible] W variable				

@ 120 VAC AC Current:	30 5[illegible] MHz	[illegible] 174 MHz	406 42[illegible] MHz 45[illegible] MHz
Standby	[illegible] A	[illegible] A	[illegible] A
[illegible]	4 [illegible] A	[illegible] A	[illegible] A

Weight [illegible]: [illegible]

Dimensions: [illegible]

Metering options: [illegible]

Transmitter

	LB	HB	UHF
RF power output:	[illegible] W variable	[illegible] W variable	[illegible]
Output impedance	[illegible] Ohms		
Spurious and harmonics emissions:	[illegible]		
Transmitter sideband noise:	[illegible]	[illegible]	[illegible]
Frequency stability:	[illegible] ambient [illegible]	[illegible] ambient [illegible] 25°C ref	[illegible] ambient [illegible] 25°C ref
All Bands Simulcast Models:	[illegible] PPM from [illegible] °C to + 60°C [illegible] PPM per year aging		
Audio sensitivity:	[illegible]		[illegible]
Remote telephone line Audio response:	[illegible] 1000 Hz		
Flat audio response:	[illegible] 1000 Hz [illegible]		
Audio distortion:	[illegible]		
Modulation:	[illegible] 1000 Hz		

[illegible]

FCC INFORMATION
[illegible]

MODEL	FREQ. RANGE (MHz)	POWER OUTPUT (WATTS)	STABILITY	TYPE ACCEPTANCE NUMBER
[illegible]2B	[illegible]	[illegible]	[illegible]	AB[illegible]
[illegible]2B	[illegible]	[illegible]	HSS	AB[illegible]
[illegible]2B	[illegible] 174	[illegible]	[illegible]	[illegible]
[illegible]2B	[illegible] 174	[illegible]	HSS	[illegible]
[illegible]4 2B	4[illegible] 4[illegible]	[illegible]	[illegible]	AB[illegible]
	4[illegible] 4[illegible]	[illegible]	[illegible]	AB[illegible]
	4[illegible]	[illegible]	[illegible]	AB[illegible]
[illegible]4 2B	4[illegible] 4[illegible]	[illegible]	HSS	AB[illegible]
	4[illegible] 4[illegible]	[illegible]	HSS	AB[illegible]
	4[illegible]	[illegible]	HSS	AB[illegible]

HSS [illegible] PPM [illegible]
[illegible] PPM per year aging

Monitor Receiver

	LB	HB	UHF
Channel Spacing:	20 kHz	30 kHz (25 KHz)	25 kHz
Frequency stability	± .0005% from −30°C to +60°C ambient (+25°C ref.)	± .0005% (± .0002%) from −30°C to +60°C ambient (+25°C ref.)	± .0002% from −30°C to +60°C ambient (+25°C ref.)
Sensitivity: 20 dB quieting	.35 μV	[illegible] μV	.5 μV
EIA SINAD:	.25 μV	[illegible] μV	.35 μV
Selectivity EIA SINAD	[illegible]00 dB at ± 20 kHz	[illegible]00 dB at ± 30 kHz*	−90 dB at ± 25 kHz
Intermodulation EIA SINAD:	80 dB	[illegible] dB	85 dB
Squelch sensitivity Carrier squelch (adj.):	[illegible] μV or less at threshold	.20 μV or less at threshold	.25 μV or less at threshold
EIA modulation acceptance:	± 7 kHz		
Spurious & image rejection:	100 dB minimum		
Audio distortion:	3% at 1000 Hz (Line)		
Audio response:	+ 1 − 3 dB from 6 dB octave de-emphasis 300 3000 Hz		
Hum & noise:	[illegible] dB (Line)		
Audio output:	+ [illegible] dBm at 600 Ohms		
Local Speaker:	[illegible] watts at [illegible] Ohms		
Distortion:	[illegible] at 1000 Hz (Loc. Spkr)		
Hum & noise:	50 dB (Loc. Spkr)		

*[illegible] dB @ 25 kHz

Link Receiver

	[illegible] 76 MHz	406 420 MHz 450 512 MHz	928 960 MHz
Channel spacing:	20 kHz	25 kHz	25 kHz
EIA modulation acceptance:	± 7 kHz	± 7 kHz	± 8 kHz
Frequency stability: from −30°C to +60°C ambient (+25°C reference)	± .0005%	± .0005%	± .0002%
Sensitivity 20 dB quieting:	[illegible] μV ([illegible] μV with EIA 6 dB octave de-emphasis)		
Selectivity:	[illegible] dB at 20 kHz	−85 dB at 25 kHz	−90 dB at 25 kHz
Intermodulation:	[illegible] dB	−[illegible] dB	−[illegible] dB
Spurious & image rejection:	[illegible] dB	[illegible] dB	[illegible] dB
Squelch sensitivity Digital coded:	.25 μV or less		
Flat audio response:	[illegible]		
Audio output:	[illegible] dBm at [illegible] Ohms		
Local speaker (optional):	[illegible] watts		
Hum & noise:	[illegible] dB		

MOTOROLA
Communications and Electronics Inc.

A subsidiary of Motorola, Inc.
1301 E. Algonquin Road, Schaumburg, Illinois 60196
Telephone (312) 397-1000

Eq Cat	Sec.	Item
R3	5	96C

MOTOROLA

Official Radio Communications Sponsor for the 1984 Olympic Games

MODEN Plus
Microprocessor–Controlled Paging Encoder

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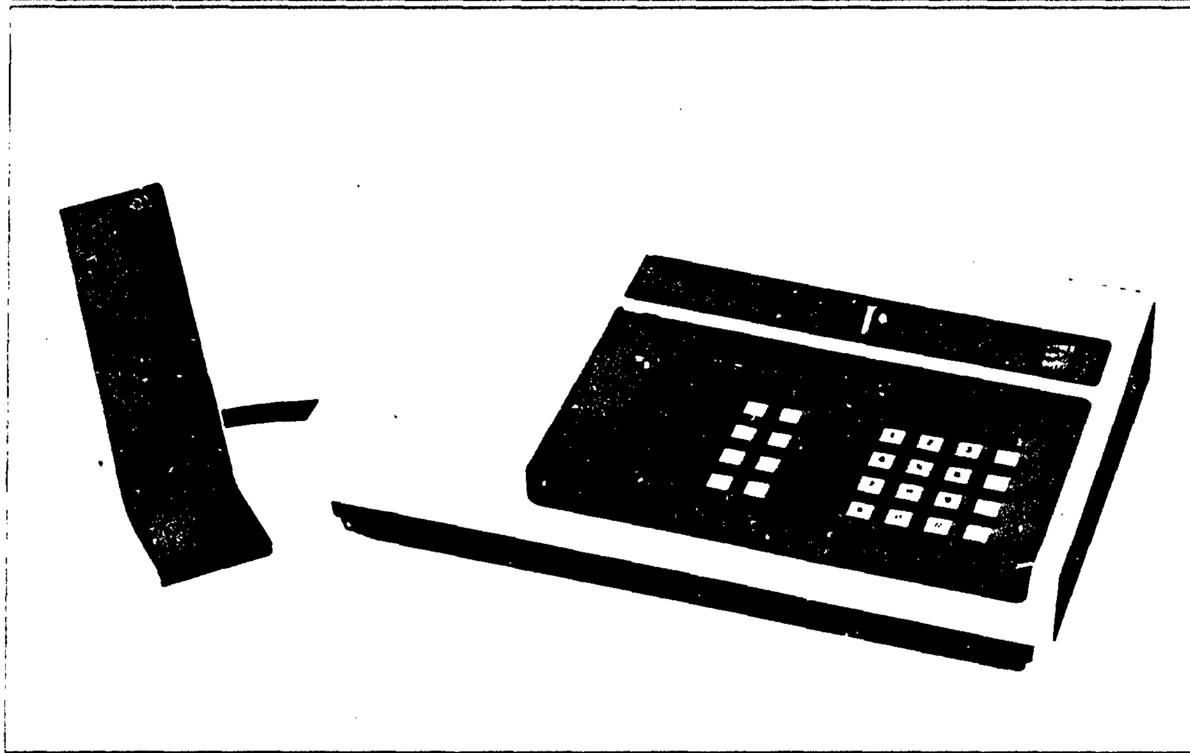

Motorola s reliable, microprocessor-controlled paging encoder is a completely self-contained control point package which provides either local or remote control of base stations. Control of one local or two remote (tone or tone-plus-binary) stations is supported. Providing service for up to 2.000 users with up to 4 addresses each, the MODEN Plus generates ALL Motorola paging signalling types. It signals tone-only, tone-and-voice, numeric and alphanumeric display pagers.

FEATURES:

- Multiple Mixed Coding Types
- Display Pager Encoding
- Supervisory Control Point Operation
- Intercom
- Tone and Display Message Memory Queue
- 2.000 Users 4 Addresses
- Tone, Binary, (Local or Remote), Binary & Voice (Remote Only), Base Station Control
- Local Lockout
- Large 16-Digit Liquid Crystal Display with User Prompts
- Two Contact Closures for Alarm Pagers
- Microprocessor-Controlled
- Self-Test Diagnostics at Power-Up
- Key Lockable On Off Switch
- Keyboard Modifiable System Configuration Parameters
- 12VDC Operation with an External Emergency Battery
- Random or Radio Coded Group Call
- Control of Two Radio Channels

OPTIONS:

- Line Operated Transmit Lockout & Control (LOTL)
- Alphanumeric Expansion – RS232 Dual Ports for Full Alphanumeric Capability
- Modem for dedicated or Dial-Up Remote Video Display Terminal Message Input

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MODEN Plus Paging Encoder

FEATURES	DESCRIPTION	BENEFITS
Multiple Mixed Coding Types	The MODEN Plus product signals tone-alert, tone-and-voice and display pagers. This includes all Motorola 2-Tone, 5/6-Tone, and Golay Sequential Code (GSC) pager types	Permits use of existing pagers while upgrading to newer faster signalling units. More user capability, more system capacity and more effective use of air time are achieved
2,000 Users 4 Addresses	The MODEN Plus has the ability to signal up to 2000 users with up to four addresses each	Can be used in small to medium paging environments
Tone, Binary, or Binary and Voice (Local or Remote) Base Station Control	Local control via hardwire or remote control via dedicated phone lines is provided by the encoder. Binary and voice base station control is also provided	Complete installation flexibility providing the most cost effective solution for your individual control line needs. Provides a complete control point and/or back-up for a dial terminal
Local Lockout	The MODEN Plus can share a common base station. When the channel is in use, the encoder locks out disabling its operation until the channel is clear	Effective sharing of dedicated lines that drive a common base station, when multiple encoders are located within one facility
16-Digit Display with User Prompts	Large 0.5 LCD readouts reduce operator fatigue and chance of error. The encoder prompts the operator for the data entry sequence, and verifies proper format, valid characters and message length	Human engineered for simplicity, the encoder enables your dispatcher to quickly and efficiently handle paging calls. Error is reduced and the readout provides positive feedback via display of the encoded pager number and data
User Modifiable System Configuration Parameters	Encoder modifiable parameters include pager types, codes and radio channel by 100's digit, alarm page numbers, and TCU type. Password protected access to key parameters. Internal back-up battery retains configuration parameters during extended power loss	Easy modification of configuration parameters, protected against unauthorized changes. No need for factory reprogramming as system grows or as pager mix changes
Two Contact Closure Alarm Pages	Automatic pager signalling when burglar alarm system and/or fire alarm system activates. Two encoder keyboard programmable pager numbers to alert guard. Each alarm has a unique siren tone which is transmitted	Quick notification of an alarm condition, even in unattended buildings
Microprocessor-Controlled	The entire operation of the encoder is controlled via a Motorola MC6809 microprocessor. The general operating characteristics of the encoder reside in replaceable ROM. Programmable memory allows field selection of customer operating parameters	Easy to use. Provides increased functions (i.e. complex coding schemes, multiple code types, prompts, etc.). Replaceable ROMs allow the unit to grow into a more complex system. Internal battery back-up preserves configuration during power loss
Self-Test Diagnostics at Power-Up	When restoration of service occurs after a power loss, and at initial turn-on, the microprocessor immediately checks to see that the encoder is functioning properly	The system operator can be assured that the encoder is functioning correctly, or quickly initiate action if repair is required
Key Lockable On/Off Switch	A key is used to turn the unit on and off	Eliminates unauthorized terminal usage
D.C. Operation with External (Customer Supplied Battery) Source	Retention of service during AC power fail conditions	The encoder will still operate when power is lost by switching to an external D.C. source
Numeric Display Paging	Numeric display pagers can be signalled and up to 24 digits can be sent. Special alphabetic characters can be sent to those numeric display radios with this capability	Allows display of telephone numbers or special codes on the pager. Adds display paging to an existing system
Alphanumeric Display Paging	A limited set of alphabetic characters is available on the encoder keyboard. Full alphabetic capability requires the alphanumeric expansion option and a video display terminal (VDT)	Allows short, spelled out, messages from the encoder keyboard to Numeric and Alphanumeric OPTRX pagers
Tone or Data Display Memory	Up to 20 tone-alert or display pages can be stored until the radio channel is available	The stored pages are automatically sent when the channel is clear. The operator does not have to wait to input calls
Two-Channel Operation	Control of two separate remote transmitter lines is possible. Pages are automatically directed to the correct channel	Easy addition of display paging on two radio channels. Pagers are programmed by 100's group to the correct channel by the encoder configuration
Control Point Operation	The necessary FCC requirements for a licensed control point are provided, such as supervisory takeover and visual indication of transmit conditions. Intercom to the dispatch points is provided	Up to 5 other dispatch point encoders can operate in parallel to the control point. No additional control console is required. The encoder can serve as control point while backing up a dial terminal
Random Make Up Group Call	Up to 5 groups of 15 pagers may be called, each group is accessed with one paging number. Groups may be combined to provide more than 15 pagers per group call	Rapid calling of special groups. Group members may be changed without changes in radio coding

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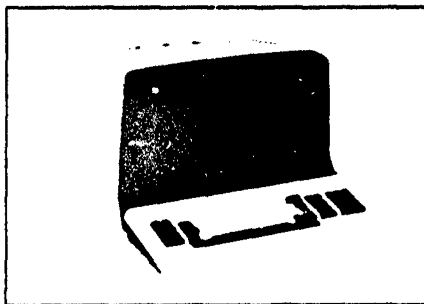

Video Display Terminal (VDT) (Motorola or customer provided) are used with the Alphanumeric expansion option to provide full alphabetic message capability.

FEATURES	DESCRIPTION	BENEFITS
Automatic Station Identification	Up to 10 Morse code characters and the time between automatic transmissions are keyboard programmable for each of 2 radio channels.	Removes the requirement for operator manual station identification.
PL or DPL Monitor & Transmit Control	The PL monitor button enables removal of PL squelch for channel monitoring. Transmit PL is removed during paging transmissions and left on during two-way conversation	Eliminate disturbance of co-user two-way receivers during pages but permits talking to them when desired
Automatic or Manual Voice Transmission	The encoder can be configured for either voice paging followed by a preset talk time, voice operated talk time or manual push-to-talk control.	Allows system to be set up to match user requirements. Eases operator s job.
Voltage Surge Protection	Both the AC input line and the base station control line are protected against high voltage transients	Reduces possibility of damage to the encoder due to lightning or input line voltage induced voltage spike.
Headset Jack	Allows use of convenient operator headset instead of the desk microphone accessory	Reduces operator fatigue and permits ease of dispatch Particularly useful in high traffic systems.

OPTIONS	DESCRIPTION	BENEFITS
LOTL (Line Operated Transmit Lockout)	The MODEN Plus can share a common base station When the channel is in use, the LOTL senses the control signal and locks out the encoder disabling its operat[illegible] until the channel is clear	Effective sharing of dedicated lines that drive a common base station, when multiple encoders are not located within the same facility
Alphanumeric Expansion	An RS-232 interface allow[illegible] two video display terminals to interconnect. These may be local or with modems dedicated or dial-up remote inputs	Provides multiple inputs for generation of alphanumeric messages From VDTs or computers emulating a VDT

MODEN Plus Paging Encoder

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OF MOTOROLA, INC.

Performance Specifications

Model:	E08PLS 2000 __ T
Number Capacity:	2,000 User codes with up to 4 addresses each.
Page Code Types:	2-Tone, 5/6-Tone, Golay Sequential Code (GSC)
Paging Tones: Output:	Adjustable to +5 dBm maximum @ <3% distortion ±3 dBm @ 300-3,000 Hz, reference 1,000 Hz into a 600 ohm load; 6 dB per octave de-emphasis or flat response.
Stability/Accuracy:	+0.15%, 0°C to +50°C (25°C reference).
Channel Monitor Audio:	1W @ <5% distortion. Volume control settable.
Dimensions:	4"x15"x10" (102x381x254 mm) (Height x Width x Depth)
Operating Temperature Range:	0°C to +50°C Ambient, 25°C reference.
Weight:	10 lbs. (4.54 kg)
Supply Voltage:	117 VAC 50/60 Hz; 12 VDC; 230VAC Field Settable
Power Consumption:	50W
Transmitter Control.	Remote: Tone or PURC (Paging Universal Remote Control) binary remote control, one or two transmitters. Local: One transmitter. (PURC local not available.)
Alarm Page:	Two remote closure activated pages. Alert codes settable to any two addresses. Separate audible siren tones transmitted for each.
Group Call:	Random: Maximum of 5 groups with up to 15 random addresses. Radio: Motorola "Tone B" and GSC group call.
Memory:	Up to 20 tone-alert or display pages of 24 characters each. Longer messages take up more than one memory location.
Automatic Station Identifier:	Up to 10 characters per channel with settable transmit interval time.
Voice Page:	Manual push-to-talk, pre-timed (settable), or voice operated transmit.
Display Page:	Basic unit provides the following alphabetic characters, in addition to the numeric, for transmission to OPTRX Display Pagers: A, B, C, D, E, F, G, H, I, J, L, N, O, P, S & U

Full Alphanumeric Expansion

Ports:	Two
Data:	RS-232C Signalling, 7 bit ASCII with start, stop bit, odd parity
Rate:	150, 300, 600, 1200, 2400, 4800, 9600 Baud rates, selectable
Connection, VDU:	Hard wire local: 4 wires, 50 feet max. Remote: Bell 103 modem or equivalent, 300 baud rate Bell 212A or equivalent, 1200 baud rate
Input Device(s):	VDT or computer, emulating VDT, per Motorola defined format*.

* For full details refer to the MODEN Plus System Planner 68P81026C35-A

Support Services
Wherever Motorola sells, our product is backed by service. In the U.S., we have 900 authorized or company-owned centers. In addition, our products are serviced throughout the world by a wide network of company or authorized independent distributor service organizations.

MOTOROLA
1301 East Algonquin Rd., Schaumburg, Illinois 60196
(312) 397-1000

Specifications subject to change without notice.

6 dB or
9 dB GAIN

DB-224
118-174 MHz

BROAD BAND GAIN ANTENNA

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OF DECIBEL PRODUCTS, INC.

MODEL DB-224 is a high gain, light weight, high strength antenna for use in the 118-174 MHz band. It is factory adjusted and checked for minimum VSWR over a wide band of frequencies. Clamps for top mounting are supplied with the antenna but an additional side mount kit (Model DB-5001) must be ordered when side mounting the antenna.

OPTIONAL RADIATION PATTERN. The radiation pattern of the DB-224 can be easily changed from a 6 dB gain omni-directional pattern to a 9 dB maximum gain offset pattern, or from an offset to an omni-directional pattern. When the four dipole elements are positioned evenly, every 90 degrees around the mast, a circular radiation pattern results. When all four dipoles are in line (collinear) along one side of the mast the antenna has a directional characteristic.

BANDWIDTH. Through the use of folded dipole elements and binary cable harness, the DB-224 has an exceptionally broad bandwidth. Performance characteristics (gain, VSWR) are essenitally constant over a frequency range of 10 MHz or more. This permits the DB-224 to provide optimum performance when used in either single or multi-frequency systems.

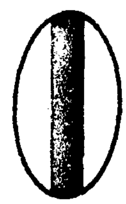
TWO PIECE MAST. For ease of handling and to facilitate shipment, the mast is made in two sections. Assembly of the sections is quite simple and requires only the use of ordinary hand tools. The unique center splice assures proper alignment. (See illustration).

LIGHTNING PROTECTION. Superior protection against lightning damage is provided by the aluminum mast with pointed top cap which provides a positive low resistance discharge path to tower or ground system. The radiators are operated at DC ground to provide further protection against lightning and static build-up.

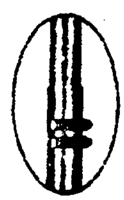
SPLIT VERSION. A split version of the DB-224 is available in both omni-directional and offset radiation patterns. Essentially it amounts to two 3 dB gain omni-directional or two 6 dB gain offset antennas on a single mast. Separate feed lines are provided to the two antennas.

DB-224E
(offset pattern)

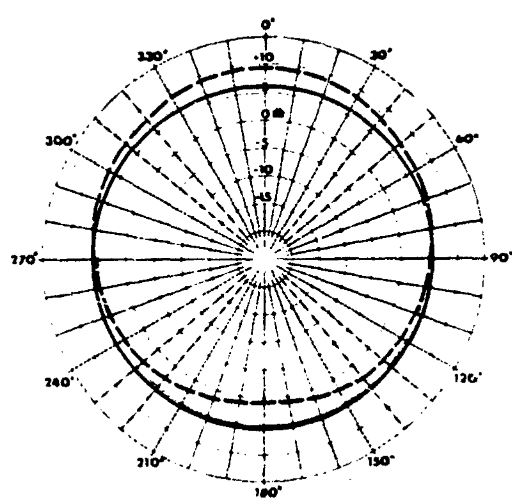
Simple but secure stainless steel banding clamp allows an easy change from circular to offset radiation pattern.



Molded connections for weatherproof operation.



Unique center splice prevents misalignment; two piece construction for easier handling before installation.



Horizontal patterns illustrate the maximum gain of the DB-224 (6dB) and DB-224E (9dB) with respect to a half wave dipole (0dB level).

DB-224
(omni pattern)

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Figure 1

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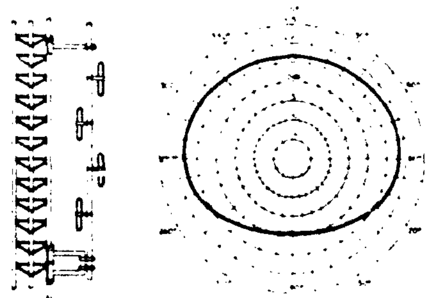
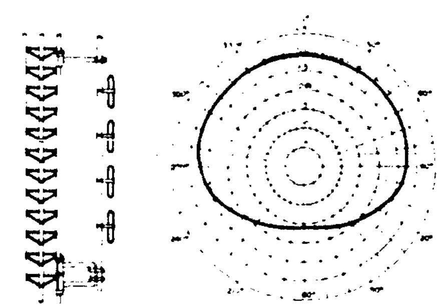
SIDE MOUNTING

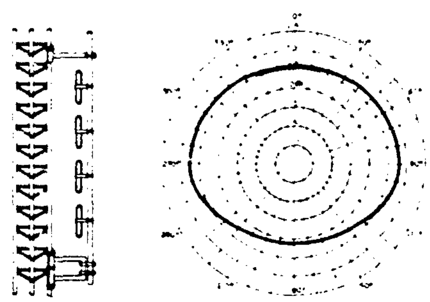
When the **DB-224** and **DB-224E** antennas are mounted to the side of a tower the horizontal radiation pattern necessarily becomes distorted. The patterns shown below indicate the typical pattern shape of the antenna side mounted on a tower with an 18" to 24" face using the DB-5001 Side Mount Kit.



DB-224 (omni) mounted on side of tower



DB-224E, elements pointed away from the tower



DB-224E, elements pointed toward the tower

The **DB-5001** Side Mount Kit positions the antenna approximately 18" from the tower and consists of an upper sway brace, lower bracket (both galvanized) and the necessary hardware for attaching the bracket to round tower members up to 3" OD, or angular members up to 2" on a side. Other size clamps can be supplied on special order.

ORDERING INFORMATION

Model	**Frequency**
DB-224 Antenna, circular pattern	Specify exact
DB-224E Antenna, offset pattern	frequency(s) or
DB-224S Split Antenna, circular	frequency range
DB-224ES Split Antenna, offset	(and termination if
DB-5001 Side Mount Kit	non-standard)

BANDWIDTH

In the frequency range 118-144 MHz the DB-224 is manufactured to order at the specified frequency. The bandwidth is approximately ± 2% of frequency for a VSWR less than 1.5:1.

In the frequency range 144 to 174 MHz the DB-224 is available in four frequency ranges from 144 to 150 MHz, 150 to 160 MHz, 155 to 165 MHz, or 164 to 174 MHz.

DB-224S, SPLIT VERSION

The DB-224S is a split version of the DB-224. It consists, essentially, of two independent antennas on the same mast, each with a separate feedline terminated at the bottom of the mast. Each antenna has 3 dB gain in an omni-directional pattern (DB-224S) or 6 dB gain in an offset pattern (DB-224ES). Each antenna may be used omni-directionally or directionally without regard to the other. Isolation between the two antennas is 35 dB or more.

ELECTRICAL DATA

Frequency Ranges:

A Range	150-160 MHz
B Range	155-165 MHz
C Range	164-174 MHz
D Range	118-144 MHz*
E Range	144-150 MHz*
Bandwidth (150-174 MHz)	10 MHz
VSWR	1.5 to 1 or less
Nominal impedance	50 ohms
Gain (over half wave dipole)	
Omni pattern	6.0 dB
Offset pattern	9.0 dB
Maximum power input	500 watts
Vertical pattern beamwidth (half power points)	16°
Decoupling between antennas (split models)	35 dB minimum
Lightning protection	Direct ground

Standard Termination: Captive Type N male attached to end of flexible lead. Other fittings are available on special order.

*Gain and bandwidth are reduced in the 118-150 MHz band. Contact factory for details.

MECHANICAL DATA

Materials:

Mast — upper	6061-T6 Aluminum 1¾" OD with 3/16" to ⅛" wall
Mast — lower	6061-T6 Aluminum 2" OD with ⅛" to 3/16" wall
Radiating elements	6063-T832 Aluminum ½" OD with .058" wall
Mounting clamps	Galvanized steel
Maximum exposed area (flat plate equivalent)	3.15 sq. ft.
Lateral thrust at 100 mph (40 psf flat equivalent)	126 lbs.
Bending moment at top clamp at 100 mph (40 psf flat equivalent)	1020 ft. lbs.
Wind rating *	
Survival (w/o ice)	100 mph
Survival (½" radial ice)	74 mph
Overall length (150-174 MHz)	255 in.
Shipping length	148 in.
Net weight (w/clamps)	32 lbs.
Shipping weight (w/clamps)	48 lbs.

Mounting Clamps (DB-365) are supplied with the antenna and fit round tower members up to 2¾" OD, angle members up to 2½". Other size clamps can be furnished on special order.

*Top mounted antenna. Wind rating is greatly increased when antenna is side mounted with appropriate side mount kit.

NOTE: The mechanical specifications are degraded for the antenna covering the 118-150 MHz band.

DECIBEL PRODUCTS, INC.

P. O. BOX 47128 • 3184 QUEBEC • DALLAS, TEXAS 75247 • 214 631-0310

Eq. Cat.	Sec.	Item
R3	05	104A

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Official Radio Pager of the 1984 Olympics

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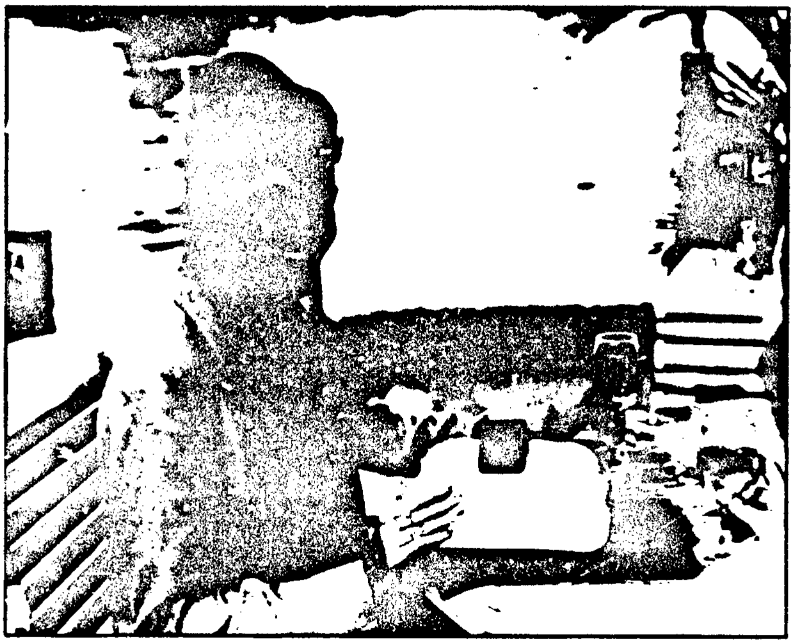
ENVOY

Tone and Visual Alert Radio Pager

Binary Digital Golay Sequential Code
Four Address
33-37, 41-45 MHz (Low Band)
138-174 MHz (High Band)
450-480 MHz (UHF)
A "PEOPLE FINDER" Radio Pager

FEATURES:

- Tone and Visual Alerting
- AA Alkaline Battery
- MEM-O-LERT Deferred Paging Storage
- Low Battery Alert
- Small, Attractive Style
- Removable Clip
- Golay Sequential Code
- VIBRA-PAGE Silent Alerting Option
- Auto Reset
- Four Address Operation



The ENVOY tone and visual alert radio pager provides fast one-way communications, high reliability, and the styling pager users demand. Ultra-compact, lightweight, and attractive, this radio pager is slim enough to fit comfortably into almost any pocket or purse. An optional lanyard provides users added flexibility.

FEATURES	DESCRIPTION	BENEFITS
Small, Attractive Style	The compact ENVOY radio pager weighs less than 4 ounces with battery. Its softly contoured polycarbonate housing presents the professional appearance you deserve.	Provides wearing comfort in any position.
Removable Clip	Your ENVOY radio pager is equipped with a sturdy butterfly clip which may be easily removed. For user versatility, an optional lanyard is available.	The pager can be firmly clipped to belts or clothing or used clipless in the pocket, briefcase, or purse. The lanyard affords the user enhanced security in preventing the loss or breakage of the pager.
AA Alkaline Battery	The ENVOY radio pager requires a single AA alkaline battery for its power.	Inexpensive and readily available thus allowing convenient replacement.
Battery Monitor	When the battery voltage drops to a marginal level, the pager emits a 10-second warble alert. Although low on power, the ENVOY radio pager will continue to receive pages for several days.	This monitor alert is a convenient reminder to replace the AA alkaline battery at the first opportunity. You won't be inconvenienced by an abrupt lack of service, miss important messages, or worry about the battery's voltage level.

MEM-O-LERT Deferred Paging Storage	If a page is received while the pager is in the silent position, the pager will immediately emit a visual alert for 10 seconds and then store. At a later time, the user can press the switch to retrieve stored pages. Messages are also stored in the "on" position after 10 seconds for audible and visual retrieval at a later time.	Offers the ability to store a page when desired. When a page might disturb others, the user can set the pager in the silent mode to receive a page without sounding the alert tone.
Loud, Clear Alert Tone	The ENVOY radio pager offers 84dB sound pressure level at 12 inches.	Alert tones will be loud and clear, even in areas with high ambient noise.
Long Battery Life	The electronic design of the ENVOY radio pager minimizes the amount of current consumption required for operation.	Users will enjoy longer intervals of pager service before replacement of the battery.

OPERATIONAL FEATURES	DESCRIPTION	BENEFITS
Tone and Visual Alert	When in the "on" position, the Motorola ENVOY tone and visual alert allows you to be alerted simultaneously by a beep and light indicator. When in the silent position, only the light indicator is generated.	The ENVOY radio pager allows for the flexibility of successful alerting in environments as diverse as theatres, churches, courtrooms, construction sites, manufacturing plants, and airports.
Four Address Operation	Four separate paging alerts are provided with your ENVOY radio pager.	Provides priority alert capability or contact with four paging locations, such as home, office, answering service or neighbor.
Auto Reset	The page alert automatically resets itself after a 10-second alert.	Allows hands-free operation and battery life conservation.

OPTIONAL FEATURE	DESCRIPTION	BENEFITS
VIBRA–PAGE Silent Alert Capability	This vibrating option uses a cartridge with a mercury N-cell battery and vibrating motor which replaces the AA alkaline battery.	Permits users to silently receive and distinguish messages from four different sources with complete privacy.

RELIABILITY FEATURE	DESCRIPTION	BENEFITS
Accelerated Life Test	The unique Motorola Accelerated Life Test is a proprietary process developed to simulate five years of field stress in several weeks. Motorola pagers are subjected to the ALT process — in design, at preproduction, and during their product life cycle.	Motorola's ALT assures product reliability.

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ENVOY Tone and Visual Alert Radio Pager

Performance Specifications

Model Series:	A01GAC4668AA	A03GAC4668AA	A04GAC4668AA
Frequency:	33-37 MHz 41-45 MHz	138-174 MHz	450-480 MHz
Size: **(without clip)**	2.78" x 2.05" x 0.71" (7.06cm x 5.20cm x 1.80cm)	2.78" x 2.05" x 0.71" (7.06cm x 5.20cm x 1.80cm)	2.78" x 2.05" x 0.71" (7.06cm x 5.20cm x 1.80cm)
Weight: **(without battery)**	2.19 ounces (62 grams)	2.08 ounces (59 grams)	2.19 ounces (62 grams)
Battery Complement:	One 1.5 Volt AA Size Disposable (Alkaline)	One 1.5 Volt AA Size Disposable (Alkaline)	One 1.5 Volt AA Size Disposable (Alkaline)
Battery Life in weeks: **(typical) (assuming 8 hours per day 40 hrs. per week, .15 call per user-hour (peak) full capacity battery)**	About 14 weeks (6 weeks without battery saver)	About 19 weeks (6 weeks without battery saver)	About 19 weeks (6 weeks without battery saver)
Power Consumption:	7.2ma (2.5ma Standby)	7.2ma (1.6ma Standby)	7.2ma (1.6ma Standby)
System Call Time:	4.4 Calls per second	4.4 Calls per second	4.4 Calls per second
System Coding:	Golay Sequential	Golay Sequential	Golay Sequential
Maximum Address Capacity:	4,000,000 Unique Codes	4,000,000 Unique Codes	4,000,000 Unique Codes
Field Strength Sensitivity: **(paging)**	5μV per meter	5μV per meter	15μV per meter
Adjacent Channel Selectivity:	60 dB at ± 20 KHz	50 dB at ± 30 KHz 65 dB at ± 25 KHz (Int'l)	60 dB at ± 25 KHz
Spurious and Image Rejection:	55 dB	60 dB	45 dB
Frequency Stability: **−10°C to +50°C, 25°C ref.**	± 0.002%	± 0.002%	± 0.0005%
Alert Tone Output:	84 dB minimum at 12"	84 dB minimum at 12"	84 dB minimum at 12"
Alert Tone Length:	10 sec ± 0.5 sec unless manually reset	10 sec ± 0.5 sec unless manually reset	10 sec ± 0.5 sec unless manually reset
Alert Tone Frequency:	3200 Hz	3200 Hz	3200 Hz

MOTOROLA Customer Service

Support Services
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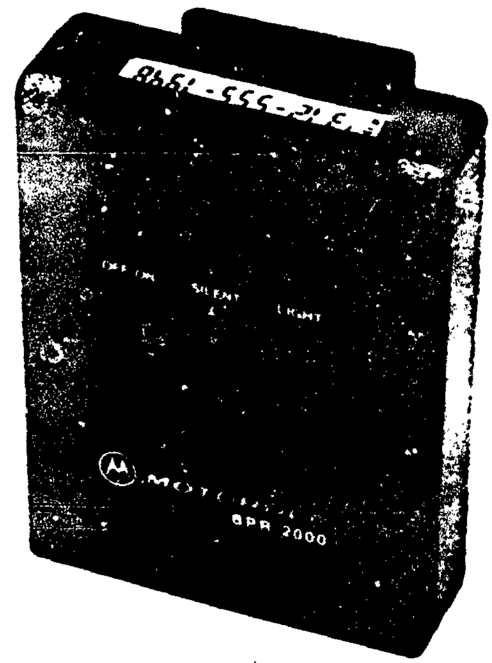
BPR 2000
Display Radio Pager
Binary Digital, Golay Sequential Code
Dual Address and Numeric Display

Features:

- **Full 12-Digit Liquid Crystal Display**
- **Top Mounted Display for Easy Reading**
- **Dual Source Identifier**
- **Microprocessor Decoder**
- **Four Dynamically Allocated Message Memories**
- **Duplicate Message Detection**
- **Available with VIBRA-PAGE Silent Alerting**
- **Rechargeable Nickel-Cadmium Battery**
- **AA Alkaline Battery**
- **Temperature Compensated Display**
- **Low Battery Indicator**
- **Light for Night Viewing**
- **Available with Charger**

A PEOPLE FINDER Radio Pager



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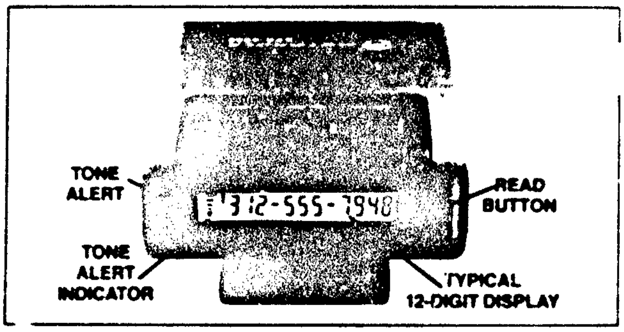
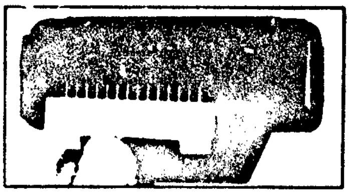
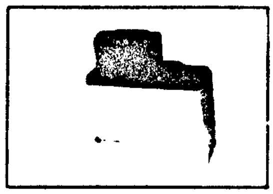
BPR 2000 Display Radio Pager

The BPR 2000 Display Pager will receive and display numeric messages of up to 23 digits. This allows telephone numbers, part numbers, or coded messages to be sent to the pager. The information display gives you greater utility than an ordinary tone alert pager. This gives you more reliable communications, especially in noisy environments.

This high quality communications device incorporates Motorola's most advanced microprocessor technology along with the same high performance receiver proven in Motorola's popular BPR 2000 series tone-and-voice and tone alert pagers. Its rugged mechanical design assimilates the proven features of the BPR 2000 family of product. To achieve a superior degree of dependability, the BPR 2000 display pager has met rigorous reliability standards and stringent quality controls at all stages of design and production. You can rely on the BPR 2000 display pager to receive your message, save you time, and maximize your efficiency.







	Description	Advantages
Unread Message Indicator	Whenever a new page comes in, a unique "checkerboard" pattern appears on the display until the "read" switch is depressed	Even if you turn off the alert tone the next time you look at your pager, you'll know you've been paged
Automatic Reset	The alert will stop after eight seconds or can be manually reset before eight seconds.	If your hands are occupied when you receive a page, it isn't necessary to interrupt your activity to turn off the alert
Continuous "On" Indication	After a power-up alert and brief display segment check, the pager displays the "audio on" symbol and all dashes. When the pager is placed in the "silent" mode, the "audio on" symbol will disappear, but the dashes remain ------------	A glance at the pager assures you your unit is on
Automatic Display Continuation and Reset	The display will reset to the "on" mode 12 seconds after the "read" switch is depressed, unless there are more than 12 characters in your message. In that case the 12th character will be a lower case "c" to denote continuation. The rest of the message will be displayed when the "read" switch is depressed again, or it will be automatically displayed after 12 seconds	Operation is simple. One push of the "read" switch, and the pager does the rest
Lighted Display	A separate switch on the front of the pager can be pushed to illuminate the display	Your message can be conveniently read whenever you're in a dark surrounding, a theatre, a restaurant, a nightclub, etc.
Silent Paging	The "silent" switch allows you to turn off the audible alert tone. The alert tone display will go out indicating silent mode operation	In meetings or at other times when the alerting beep may be undesirable, you may defeat it yet continue to receive display messages
Unread Message Indicator	Whenever a new page comes in, a unique "checkerboard" pattern appears on the display until the "read" switch is pressed	Just a glance at the display will let you know if you've been paged
VIBRA-PAGE Alerting Model	The pager can be ordered equipped with a miniature motor that causes the pager to vibrate when a message is received in the "silent" mode	With this model it is possible to receive information immediately and discreetly. This feature is available with either the AA alkaline or AA nickel-cadmium battery

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Features	Description	Advantages
AA Alkaline Battery or Rechargeable AA Nickel-Cadmium Battery and Single Unit Charger	The BPR 2000 radio pager requires only one AA Alkaline battery or one AA rechargeable Nickel-Cadmium Battery for its power. The Single unit battery charger allows one pager and one spare battery to be charged simultaneously.	The replaceable alkaline battery can be purchased at virtually any drug, grocery, or discount store, a convenience matched by the battery charging unit for the nickel-cadmium battery. The charger is a convenient place to store your pager while prolonging usage life. Two L.E.D.'s on the charging unit indicate when pager and/or spare battery are in charging mode.
Long Battery Life	The pager incorporates special battery saving circuitry minimizing the amount of current consumption required for operation.	The AA battery can provide the long service life you want, whether you choose the alkaline or nickel-cadmium battery.
Low Battery Indicator	When the battery approaches the end of its useful life, the pager displays the "LOLOLOLOLOLO" warning. The pager will continue to function for several days.	The pager reminds you to replace or recharge the battery at your first opportunity, but you won't be inconvenienced by an abrupt lack of service or missed messages.
Message Privacy	Only your unique pager code will permit the display of messages intended for your pager. The data will not be displayed until you depress the "read" switch.	No one can simply monitor the channel and intercept your messages, as with tone and voice. You control when the message is displayed, so bystanders can't eavesdrop – allowing you more privacy.
23-Digit Message Capacity	The pager can receive and display up to a total of 23 characters.	Additional information, such as extension number, coded caller identifier, or degree of urgency, can be appended to a phone number message.
12-Digit LCD Display	The pager can display 23-character messages in separate segments of 11 and 12 digits each.	Most telephone numbers can be shown on a single line and read all at once (e.g. 305-555-4547).
Four Memories	The pager saves up to four messages (in combinations of four 12-digit messages, two 23-digit messages, or one 23 and two 12-digit messages) until it is turned off or a new message comes in.	Gives you the ability to store up to four messages, thus lessening the chance for missed messages.
Dual Source Identifier	The pager responds to two different codes and indicates on the display which of the two codes were used. For example, your office will be identified by the prefix digit 1, or your home will be identified by the prefix digit 2.	Calls can be screened and you know where to call back for additional information. When the pager displays an unfamiliar number the source will be recognized. You can elect to go ahead and call the number or call back to the source for additional information first.
Top Mounted Display	The top mounted display is right-side-up when the pager is worn on the belt.	The message can be conveniently read. There is no need to take the pager off and hold it to read it properly.
Dual Function	In addition to its message capabilities, this pager will also respond as an efficient two-address basic tone alert pager.	These distinct alerts might designate common messages like "call your office" and "[illegible] home" to be sent quickly [illegible] and efficiently.
Temperature Compensated Display	Temperature compensating circuitry ensures that the display's high contrast and wide viewing angle are maintained over the pager's entire operating temperature range.	In hot and cold weather, when the pager alerts you, the display will be read easily.
Duplicate Message Detection	New messages [illegible] compared to messages already [illegible] in memory. If the new message [illegible] stored message from the same [illegible], the stored message is automatically moved to the first memory location.	Prevents depletion of memory capacity due to unnecessary storage of duplicated messages.

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BPR 2000 Display Radio Pager

Performance Specifications
General

Model:	A01BGB4661 or 5661 (VIBRA-PAGE)	A03BGC4661 or 5661	A04BGB4661 or 5661
Frequency:	33-37 MHz 41-50 MHz	138-174 MHz	450-512 MHz 406-420 MHz
Weight: w/Alkaline Battery:	4.7 ounces (134g) standard model 5.0 ounces (142g) VIBRA-PAGE model		
Dimensions:	3.10 x 2.30 x 0.84 in (7.87cm x 4.84cm x 2.13cm) 6.0 cubic in (97.9 cub. cm)		
Paging Sensitivity:	5µV/m	5µV/m	15µV/m
Display:	12 characters .16 in. high with a temperature compensated LCD display		
Memory:	(4) 12-character messages or (2) 23-character messages or (1) 23-character message and (2) 12-character messages		
Selectivity:	60dB at 20 KHz	60dB at 30 KHz 25 KHz Int'l	60dB at 25 KHz
Spurious & Image Rejection:	55dB	55dB	45dB
Audio Output/ Alert Tone:	83dB SPL @ 12"		
Frequency Stability:	.002% from -10°C to +50°C		.0005% from -10°C to +50°C
Power Supply:	One 1.5 volt AA Alkaline Battery or One 1.5 volt rechargeable Nickel-Cadmium Battery		
Average Life of Alkaline Battery:*	Alkaline: w battery saver 13 weeks Without Battery Saver 6 weeks Nickel-Cadmium: With Battery saver 6 weeks Without Battery Saver 2 weeks		
Code Format: **Bit Rate** **Code Capacity**	23.12 Golay Sequential Code 300 Bits/sec address 600 Bits/sec data 1,000,000 display pagers		

*Based on three 12-digit messages per 8-hour day, 5 days week

Single Unit Battery Charger

Model:	NLN5678A	NRN4273A	NRN4272A	NLN9961A
Input:	117V ac. 50-60 Hz	220V ac. 50-60 Hz Charger with Floor Transformer	220V ac. 50-60 Hz Charger with Wall Transformer	Charger with no transformer
Output:	Typical 45 mA @ 1.3Vdc			
Accommodates:	One BPR 2000 Radio Pager and One Spare Nickel-Cadmium Battery NLN7057A			
Recharge Time:	Full recharge time 12 hours for 40 hours of normal operation Part recharge time 2.5 hours for 8 hours of normal operation			
Size:	3¼" x 2½" x 4⅞"			
Weight:	12.8 oz (365g)			

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